THIRD INTERNATIONAL RUBIACEAE CONFERENCE

PROGRAMME & ABSTRACTS

Leuven, September 18-21, 2006

Scripta Botanica Belgica **40**

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front: *Emmenopterys henryi*, *Leptactina benguellensis*, *Fadogia* sp., *Spermacoce dibrachiata*
back: *Mantalania longipedunculata*, *Myonima obovata*, *Breonia chinensis*, *Luculia pinceana*
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P. De Block, S. Dessein & E. Robbrecht (eds.)

Third International Rubiaceae Conference

Programme
&
Abstracts

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Contents

Preface	5
Programme	7
Abstracts	13
Visit to Leuven	83
Visit to the National Botanic Garden of Belgium	85
Participants	87

Preface

Students working on large angiosperm families such as the orchids and legumes are faced with huge numbers of taxa. The struggle to comprehend the evolution of these speciose groups (twice to four times the number of mammals) creates a feeling of scientific solidarity. Initiatives to bring scientists together around research on one plant family are not uncommon, therefore.

Years have elapsed, however, since the first (1993) and the second (1995) Rubiaceae Conference. Young Rubiaceae researchers found the seventeenth International Botanical Congress in Vienna (2005) a good opportunity for meeting again, and took the initiative for a half day IBC Symposium "Phylogeny and deep morphology of Rubiaceae". It brought the students working on Rubiaceae together around seven lectures and a comparable amount of posters. The meeting in Vienna confirmed the great need to restart Rubiaceae conferences. We are therefore glad to introduce this volume with the programme and abstracts of the presentations given at the Third International Rubiaceae Conference held at the K.U.Leuven (Belgium), 18-21 September 2006.

One of the keynote addresses at the Conference (Birgitta Bremer) reviews the results of molecular phylogenetic work on Rubiaceae. This kind of work was hardly an issue during the second conference, but an overwhelming amount of research has seen the light since, so that an overview is most welcome. Two eminent paleontologists, Alan Graham and Steve Manchester, were found willing to prepare a survey of the fossil knowledge of Rubiaceae. Their keynote address brings novel information awaited for so long by the entire community of Rubiaceae neobotanists, since fossil data are essential in calibrating phylogenetic trees.

The other contributions were organized in six themes: systematics at family level, systematics at tribal and subtribal level, Gentianales, a better knowledge of genera, Rubiaceae checklists, and distribution patterns among Rubiaceae. A workshop should ensure the realisation of the Rubiaceae instalment in "The Families and Genera of Vascular Plants".

We are sure that the participants will enjoy the meeting, and hope that they will decide upon the organisation of future Rubiaceae conferences on a regular basis.

We acknowledge financial support from the Systematics Association, the Fund for Scientific Research – Flanders, Olympus, and Easyware. We are grateful for the help of the staff and students of the Laboratory of Plant Systematics (K.U.Leuven) and the National Botanic Garden of Belgium.

Petra De Block, Steven Dessein & Elmar Robbrecht

Organising committee
Prof. Dr. Erik Smets (Laboratory of Plant Systematics, Belgium & National Herbarium of the Netherlands)
Prof. Dr. Elmar Robbrecht (National Botanic Garden of Belgium)
Prof. Dr. Helga Ochoterena (Instituto de Biologia, Mexico)
Dr. Steven Dessein (National Botanic Garden of Belgium)
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Prof. Dr. Erik Smets (Laboratory of Plant Systematics, Belgium & National Herbarium of the Netherlands)
Prof. Dr. Elmar Robbrecht (National Botanic Garden of Belgium)
Prof. Dr. Birgitta Bremer (The Bergius Foundation, Sweden)
Prof. Dr. Charlotte Taylor (Missouri Botanical Garden, USA)

Programme

Monday 18 September

9.00-10.00 Registration and mounting of posters

10.00-10.30 Welcome by the organizers

10.30-12.00 Keynote addresses

Alan Graham & Steven Manchester – A revised fossil record of the Rubiaceae

Birgitta Bremer – A historical perspective of the phylogenetics, particularly molecular phylogenetics, of Rubiaceae

12.00-14.00 Lunch break

Session 1: Systematics at family level

14.00-15.30

Helga Ochoterena – Examination of the Rubiaceae classification according to a phylogenetic analysis of combined evidence from three genes

Jean-François Manen, Steven Dessein, Petra De Block & Elmar Robbrecht – Towards an evolutionary scenario for the coffee family (Rubiaceae, angiosperms): further insights from a supertree

Steven Jansen – Hunting for rainbows: mineral inclusions in Rubiaceae

15.30-16.00 Coffee break and posters

16.00-17.30

Suzy Huysmans, Erik Smets, Michael Hesse & Martina Weber – Bi-reticulum in Rubiaceae-pollen: typology, relation with distyly and evolution

Stefan Vinckier, Erik Smets & Suzy Huysmans – The development of pollen, tapetum and orbicules in Rubiaceae

Piero G. Delprete, Rafael Choze, Rodrigo A. Silva, Carlos R. Dufrayer – Chemotaxonomy and macroclassification of Rubiaceae

20.00-21.30 Introduction to Belgian beers

Tuesday 19 September

Session 2: Systematics at tribal and subtribal level – part 1

9.00-10.30

Sylvain Razafimandimbison, Henrik Lantz, Arnaud Mouly & Birgitta Bremer – Using combined ETS-ITS phylogeny to test morphological concepts of genera in the dioecious group of Vanguerieae

Petra De Block, Sylvain Razafimandimbison & Birgitta Bremer – Phylogeny of the tribe Pavetteae (Rubiaceae)

James Tosh, Aaron P. Davis, Steven Dessein, Petra De Block, Mike Chester, Olivier Maurin, Suzy Huysmans, Elmar Robbrecht, Mike Fay & Erik Smets – Phylogenetic relationships within *Tricalysia* related genera

10.30-11.00 Coffee break and posters

11.00-12.00

Rocio Cortés-B. & Timothy Motley – Systematics of the tribe Henriquezieae (Ixoroideae, Rubiaceae) and allies

Johan Rova, Piero Delprete & Birgitta Bremer – A phylogenetic study of the *Rondeletia* complex (Rubiaceae: Rondeletieae) using rDNA ITS, rps16 and trnL-F sequence data

12.00-13.30 Lunch break

Session 3: Systematics at tribal and subtribal level – part 2

13.30-15.30

Piero G. Delprete – Taxonomic history, phylogenetic evidence and reproductive biology of the tribe Posoquerieae (Rubiaceae, Ixoroideae)

Dorismilda Martínez, Teresa Terrazas & Helga Ochoterena – Foliar and petiole anatomy of tribe Hamelieae and other Rubiaceae

Jesper Kårehed & Birgitta Bremer – The tribe Knoxieae – a new generic classification with special emphasis on the Malagasy taxa

Inge Groeninckx, Suzy Huysmans, Claes Persson, Birgitta Bremer, Sylvain Razafimandimbison, Jesper Kårehed, Erik Smets & Steven Dessein – Evolution of the Spermacoceae (Rubiaceae) based on plastid DNA

15.30-16.00 Coffee break and posters

Session 4: Rubiaceae checklists

16.00-17.00

Piet Stoffelen, Sofie De Smedt, Steven Dessein, Inge Groeninckx, Petra De Block, Henry Engledow & Elmar Robbrecht – Towards a treatment of the Rubiaceae for 'Flore d'Afrique Centrale'

Rafaël Govaerts, David G. Frodin, Markus Ruhsam, Diane M. Bridson & Aaron P. Davis – A world checklist of Rubiaceae

Workshop

17.00-18.00 Rubiaceae treatment for 'The Families and Genera of Vascular Plants'

Wednesday 20 September

Session 5: Distribution patterns among Rubiaceae

9.00-10.30

Franck Rakotonasolo – Distribution des Gardeniinae malgaches, en particulier le genre *Hyperacanthus*

Osia Gideon – Diversity and distribution patterns of the family Rubiaceae in New Guinea

Bonaventure Sonké & Charlemagne Nguembou K. – Distribution patterns of rheophytes within Rubiaceae in Cameroon

10.30-11.00 Coffee break; posters & sale of Rubiaceae publications of the National Botanic Garden of Belgium

Session 6: Gentianales

11.00-12.00

Cynthia Frasier & Lena Struwe – A glimpse into the family tree of Loganiaceae, with a close look at *Strychnos*, using ITS sequences and their secondary structure

Lena Struwe, Richard Lathrop & Peter Smouse – Spatial evolutionary and ecological vicariance analysis of biodiversity – a new interdisciplinary approach with an example from neotropical Gentianaceae

12.00-13.30 Lunch

13.30-19.15 Visit to Leuven (including visit to brewery and chocolate factory)

19.30 Conference dinner

Thursday 21 September

Session 7: A better knowledge of genera – part 1

9.00-10.30

Ivan A. Schanzer – *Ophiorrhiza* and satellite genera – relationships and biogeography

Valerie Soza & Richard Olmstead – Molecular phylogenetics of *Galium* (Rubiaceae)

Timothy Motley – Phylogeny of *Kadua* (= *Hedyotis*): origins, biogeography, and sub-generic classification

10.30-11.00 Coffee break and posters

11.00-12.30

Ruijiang Wang – A species-level classification of Chinese *Hedyotis*

Elsa L. Cabral – Biotaxonomy of the genus *Galianthe* (Spermacoceae, Rubiaceae)

Steven Dessein, Robert Harwood, Inge Groeninckx & Elmar Robbrecht – Diversity among Australian *Spermacoce* species

12.30-14.00 Lunch break

Session 8: A better knowledge of genera – part 2

14.00-15.30

Aaron P. Davis, Olivier Maurin, Michael Chester, Esther F. Mvungi & Michael F. Fay – Phylogenetic relationships in *Coffea* (Rubiaceae) inferred from sequence data and morphology

Rocio Cortés-B., Piero Delprete & Timothy Motley – Phylogeny of *Retiniphyllum* (Retiniphylleae, Ixoroideae) based on ITS sequence data and morphology

Arnaud Mouly, Sylvain Razafimandimbison, Jacques Florence, Joël Jérémie & Birgitta Bremer – Morphological evolution within the giant genus *Ixora* (Rubiaceae) in the light of phylogenetic relationships

15.30-16.00 Closure

Abstracts

On the following pages, the abstracts of papers and posters are arranged in alphabetical order following the first author's name. It is indicated above the title whether the abstract concerns a paper or a poster. The name of the presenting author is underlined. At the moment of printing, some contributors were still uncertain about their participation. However, all abstracts submitted are included.

- Poster -

Current status of the Rubiaceae family in the National Herbarium of Venezuela (VEN)

Alix Amaya & Omaira Hokche

Fundación Instituto Botánico de Venezuela. Universidad Central de Venezuela, Venezuela

The Rubiaceae family in Venezuela occupies the third place with regard to species number after Orchidaceae and Asteraceae. It comprises 106 genera and 778 species, of which 6 genera and 254 species are endemic to Venezuela. Rubiaceae includes the country's most diverse genus, *Psychotria*, with 166 species. The Rubiaceae family is broadly distributed in Venezuela and occurs in many different regions and vegetation types: Páramos (4000 m, *Arcytophyllum*), savannahs (Llanos, *Limnosipanea*), coast-marine ambient (0 m, *Strumpfia*) and mainly cloud-forests. The family is most diverse in the Venezuelan Guayana (524 species).

This work presents the current status of the Rubiaceae family in Venezuela and the National Herbarium of Venezuela (VEN), to contribute to the knowledge of this family in the world. Information of VEN specimens was included in a database and the bibliography was reviewed. The taxonomic status of names was evaluated and the collection was updated according to the last molecular, anatomical and morphological proposals.

The results indicate that VEN holds a total of 102 genera and 583 species, represented by 16.202 exsiccatae (84% named, 16% without identification) and more than 300 type specimens. Also, the herbarium has a wood collection of 88 samples, representing 23 genera (e.g., *Sickingia*, *Genipa*, *Pogonopus*, *Posoqueria*) and 34 species.

The states in Venezuela where the most genera were collected are: Bolívar (72), Amazonas (70), Miranda (47), Yaracuy (45) and Capital District (51). The genera most broadly distributed in Venezuela are: *Amaioua*, *Borreria*, *Chiococca*, *Camellia*, *Coccocypselum*, *Coussarea*, *Coutarea*, *Diodia*, *Gonzalagunia*, *Guettarda*, *Hamelia*, *Manettia*, *Mitracarpus*, *Palicourea*, *Psychotria*, *Randia*, *Rondeletia* and *Rudgea*.

The collection of the Rubiaceae family in the National Herbarium of Venezuela represents the diversity of the family in the country. Nevertheless, it is necessary to increase the collections from the Cordillera de la Costa and the coast-marine ambient, because collections from those zones are rare.

- Poster -

The shrubby Rubiaceae associated to the river forests in a section of the area Cuao-Sipapo-Medium Orinoco (Amazonas State, Venezuela)

Neida Avendaño & Aníbal Castillo

Fundación Instituto Botánico de Venezuela. Universidad Central de Venezuela, Venezuela

The Amazon state presents great diversity and a high number of endemic plants, and these characteristics make it interesting for botanical investigation. The river forests in this region represent a water-land ecotonal system and stabilize lands adjacent to rivers, retaining sediments that influence the floristic composition. The physical-chemical characteristics of those sediments have permitted the establishment of different vegetation types such as the Igapo forests, which are of great botanical interest. Shrubby Rubiaceae are very frequent in these woody formations.

As a contribution to the study of the floristic composition of a section of the area of the Cuao-Sipapo-Medium Orinoco river, a list of the shrubby species of the Rubiaceae family was generated. Furthermore, for each species a morphological description and information on its geographical distribution is given.

The study area is located in the confluences of the Cuao-Sipapo-Medium Orinoco river, in the Municipality Autana, Amazon state, at an altitude of 80-250 m, and covers c. 800 ha along an 80 km long stretch of the riverbed. Classical methodology was used. A total of 74 shrubby species were collected and identified. They belonged to 46 genera from 22 angiosperm families. The Rubiaceae family was represented by ten genera and 25 species, representing nearly 34% of the number of shrubby species in the area. *Psychotria* was represented with the most species, notably twelve, followed by *Faramea* with three and *Palicourea* and *Chomelia* with two species each. These results confirm the reports of the significancy of the Rubiaceae in these woody riverine formations.

- Poster -

Evidence of the polyphyly of *Bikkia* (Rubiaceae) from morphological phylogeny: consequences for the New Caledonian flora

Laure Barrabé[1], Arnaud Mouly[1], Jérôme Munzinger[2] & Jean-Noël Labat[1]

[1]*Département de Systématique et Évolution, Muséum National d'Histoire Naturelle, Paris, France*
[2]*Institut de Recherche pour le Dévelopement, New Caledonia*

The genera *Bikkia* Reinw. ex Blume and *Morierina* Vieill., of the tribe Catesbaeeae (Rubiaceae: Cinchonoideae), comprise c. 20 taxa of shrubs and two tree species, respectively, all restricted to the Pacific Islands.

The polyphyly of the genus *Bikkia*, previously demonstrated from molecular studies, is confirmed by morphological phylogenetic investigations (cladistic analysis of c. 50 characters for c. 40 taxa). Two separate clades are presently recognized: the true *Bikkia* including all the littoral taxa from the whole distribution area, and a New Caledonian clade consisting of the terrestrial species, restricted to ultramafic substrates. The reinstatement of *Thiollierea* Montrouz. is proposed to accommodate these endemic New Caledonian species previously placed under *Bikkia*. The genus *Morierina* is monophyletic in the study, but its position is unclear.

Diagnostic characters are provided for *Bikkia*, *Morierina* and *Thiollierea* in the light of morphological evolution and ecological data. The consequences for the conservation of these New Caledonian threatened plants are discussed considering their rarity and their environment.

- Poster -

Diversity and disparity in Rubiaceae

Kjell Bolmgren, Torsten Eriksson & Birgitta Bremer

The Bergius Foundation, Royal Swedish Academy of Sciences, Sweden

Is Rubiaceae diverse? A non-trivial part of this question appears when one applies a phylogenetic, tree-thinking perspective, acknowledging that clades share histories and are of different age. E.g., several orders within the asterids, among them Gentianales, have been shown to have had a significantly higher diversification rate than other angiosperm clades. Therefore, the species richness of Rubiaceae may be due to key evolutionary events during the ancestral history of asterids rather than within the Rubiaceae itself.

Using a tree-thinking approach, we asked whether Rubiaceae have had a higher diversification rate compared to other Lamiid clades and which clades within the Rubiaceae, if any, represent unexpectedly rapid or slow diversification histories. A 500+ Rubiaceae species sample was used to derive a dated Rubiaceae phylogeny. For well supported clades, we compiled stem age, species numbers, and trait variance. To control for phylogenetic effects the diversity of these clades were compared using both sister-pair comparisons and a dating based approach.

Rubiaceae has almost twice as many species as its sister clade, the rest of Gentianales. This is not, however, significantly larger, according to a model of random but equal speciation and extinction rates through history. Using another model, where diversification rates are derived from the data and extinction rates are allowed to vary "between reasonable bounds", both Rubiaceae and Apocynaceae were found to have had a higher than expected diversification rate compared to the background rate of the Lamiid clade. When well-supported Rubiaceae clades were compared to the background rate, higher rates were found for the Spermacoceae, the Psychotrieae and the dry-fruited Rubieae clades, as well as for the Pavetteae and the combined Ixoreae+Vanguerieae clade, while lower diversification rates were found for the *Scyphiphora* and *Strumpfia* clades. However, when the Rubiaceae clades are compared to the background rate of Rubiaceae itself, the dry-fruited Rubieae clade is the only clade to have had a higher than expected diversification rate, while both the Retiniphylleae, Craterispermeae, Isertieae, *Chione*, *Scyphiphora*, and *Strumpfia* clades are found to have a lower than expected diversification rate. In addition to these results, sister-pair comparisons detected significantly higher species richness for clades within the Anthospermeae and the Naucleeae, and for the Ixoreae clade, but for none of the other well-supported clades within the family.

Diversity is not only species number but also variation in traits, i.e. disparity. Excluding the Ixoroideae clade, disparity was examined in relation to plant height, twig diameter, specific leaf area, and seed mass using the same set of well-supported clades within the Rubioideae and Cinchonideae clades.

- Keynote paper -

A historical perspective of phylogenetics, particularly molecular phylogenetics, of Rubiaceae

Birgitta Bremer

The Bergius Foundation, Royal Swedish Academy of Sciences, Sweden

Since the first molecular investigation of Rubiaceae in 1991 there has been a tremendous increase in knowledge about the phylogeny of the family. We now know fairly well the relationships between the different subgroups such as subfamilies and tribes and the circumscriptions of many different groups, all this based on about one hundred analyses by different authors. We have strong support for many tribes and have estimated ages for a majority of the tribes and subfamilies. It is now possible to ask exciting evolutionary questions about the diversification of the family and to integrate the important "alfa-taxonomic" work into a sound phylogenetic framework.

The most important need for the coming ten years is to get a full understanding of the family through investigation of all species. We need more collaboration between scientists in different parts of the world doing taxonomic revisions and those working with molecular tools. With a reliable phylogeny and a good classification and taxonomy, Rubiaceae could be an ideal model family for evolutionary and biodiversity studies as it harbours an extreme diversity. Still, we have less than 15 % of the species molecularly investigated. To increase this number and make fast progress, we need a collaborative project. I call for a RPP (Rubiaceae Phylogeny Project), which will allow us to produce the big tree of Rubiaceae.

- Paper -

Biotaxonomy of the genus *Galianthe* (Spermacoceae, Rubiaceae)

Elsa L. Cabral

Instituto de Botánica del Nordeste, Universidad Nacional del Nordeste, Argentina

The American genus *Galianthe* (Rubiaceae-Spermacoceae) consists of 49 species, distributed in two subgenera: subgen. *Galianthe* (South America) and subgen. *Ebelia* (Rchb.) E.L.Cabral & Bacigalupo (Central and South America) with 39 and 10 species, respectively. The main concentration and diversification centres are in Brazil, in the central and meridional planalto (28 species, 16 of which are endemic) and in central, northern and eastern Paraguay (16 species, seven of which are endemic).

Galianthe species are shrubs or sub-shrubs, mostly with a xylopodium. They have heterostylous flowers in thyrsoid or cymoid inflorescences and capsular fruits with dehiscent or indehiscent mericarps. The pollen grains are 7-8-colporate and possess a complex sexine ornamentation pattern, consisting of a suprareticulum and infrareticulum. The chromosome base number is x = 8, 12, 14, 15, with 8 being the lowest number within the tribe Spermacoceae. Representatives of *Galianthe* occur in fields, or rarely inside forests, from the lowlands up to 3000 m.

This study consists of a taxonomic revision of the genus *Galianthe*. In total, 21 new taxa are described, 16 new combinations are made, new synonyms are established and known geographical areas are expanded. Furthermore, an analysis of exo-morphological, vegetative and reproductive characters, leaf and stem anatomy is executed. Also, an overview of pollen morphology and chromosome numbers is given for all species.

- Poster -

Rubiaceae for the flora of Grão Mogol, Minas Gerais, Brazil

Marina T.V.A. Campos[1], Daniela Zappi[2], Maria Fernanda Calió[1] & José R. Pirani[1]

[1]*Universidade de São Paulo, Brazil*
[2]*Royal Botanic Gardens, Kew, England*

In Grão Mogol, 26 genera and 49 species of Rubiaceae were found. The most species rich genus in the study area is the ubiquitous *Psychotria* (seven species), closely followed by *Declieuxia* (four species). Despite their species diversity in other plant groups, the campos rupestres are not amongst the Brazilian biomes with a large proportion of endemic taxa in Rubiaceae, and the only endemics are *Hindsia irwinii*, *Faramea subbasilaris* and a possible new species of *Melanopsidium*. The region of Grão Mogol, however, displays a mosaic of different habitats and their ecotones, and as such is home to species from the Atlantic forest (*Psychotria* spp.), Cerrado (*Palicourea rigida*, *Chomelia ribesioides*, *Alibertia sessilis*, *Galianthe* spp.) and Caatinga (*Molopanthera paniculata*) vegetation.

Eighty percent of the species found in Grão Mogol are reported from other ongoing floristic work in Rubiaceae of the Campos Rupestres, namely the Flora da Serra do Cipó, Minas Gerais (34 genera, 54 species), Flora de Catolés (30 genera, 61 espécies) and Flora da Serra da Chapadinha (22 genera, 40 species), Bahia. Genera common to Grão Mogol and the Serra do Cipó are: *Alibertia*, *Amaioua*, *Augusta*, *Borreria*, *Chomelia*, *Coccocypselum*, *Declieuxia*, *Diodia*, *Emmeorrhiza*, *Faramea*, *Galianthe*, *Hillia*, *Hindsia*, *Manettia*, *Molopanthera*, *Oldenlandia*, *Palicourea*, *Perama*, *Psychotria*, *Psyllocarpus*, *Remijia*, *Richardia*, *Sabicea* and *Tocoyena*, while *Coutarea*, *Melanopsidium*, *Stachyarrhena* and *Staelia* do not occur in the Serra do Cipó.

- Poster -

Phylogenetic analysis of the subfamily Ixoroideae (Rubiaceae) based on trnL-F and rps16 sequence data

Rocio Cortés-B.[1], Piero Delprete[2] & Timothy Motley[3]

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[2]*Departamento de Biologia Geral/Botânica, Universidade Federal de Goiás, Brazil*
[3]*New York Botanical Garden, U.S.A.*

The subfamily Ixoroideae was founded by Bremekamp to include members of the Rubiaceae, characterized by having secondary pollen presentation; however, its circumscription has been largely modified since then. The clades resolved within the subfamily are discussed based on a cladistic analysis of the trnL-F intergenic spacer and the rps16 intron using a total of 112 taxa.

The phylogenetic analysis solved four clades; however, the molecular markers used are not informative enough to find resolution among them. Based on the most recent tribal circumscriptions, members of tribes included in the major clade are: Alberteae, Coffeeae, Cremasporeae, Gardenieae, Ixoreae, Mussaendeae, Octotropideae, Pavetteae, Retiniphylleae, and Vanguerieae. The second clade includes several genera traditionally placed in the subfamily Cinchonoideae in the tribes Condamineeae, Cinchoneae, and Rondeletieae, as well as members of the tribe Hippotideae. The third clade is formed by members of the tribes Henriqueziеae, Posoquerieae, and Sipaneeae. Finally, the fourth clade includes genera of the tribes Sabiceeae and Virectarieae.

Although some of these tribes have been analysed in depth, contributing greatly to the delimitation of the subfamily, there are still clades in urgent need of detailed phylogenetic studies. Additionally, more molecular markers should be explored in order to increase the resolution and have a more comprehensive hypothesis of the phylogeny of the subfamily Ixoroideae.

- Paper -

Phylogeny of *Retiniphyllum* (Retiniphylleae, Ixoroideae) based on ITS sequence data and morphology

Rocio Cortés-B.[1], Piero Delprete[2] & Timothy Motley[3]

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[3]*New York Botanical Garden, U.S.A.*

The genus *Retiniphyllum* consists of 22 species of shrubs and small trees that grow mostly in white-sand soils of the Guayana and Brazilian Shields. The delimitation of the genus has been clear throughout history because of its two collateral and pendulous ovules per locule, a condition unique in the Rubiaceae. However, for the same reason, its placement within the family has been controversial. The monophyly and the systematic position of *Retiniphyllum* and the tribe Retiniphylleae are discussed based on a phylogenetic analysis of trnL-F and rps16 sequence data. The evolutionary relationships among *Retiniphyllum* species are studied using morphological and ITS sequence data.

The results confirm the monophyly of the tribe and that of its single genus *Retiniphyllum*. The tribe is placed within the major clade of the subfamily Ixoroideae. The species-level phylogeny of *Retiniphyllum* indicates that both the hummingbird- and butterfly-pollination syndromes arose once, while the bee-pollination syndrome arose several times. In addition, characters related to stipules, inflorescences, involucels, and calyces show significant trends in the evolution of the genus.

- Paper -

Systematics of the tribe Henriquezieae (Ixoroideae, Rubiaceae) and allies

Rocio Cortés-B.[1] & Timothy Motley[2]

[1]*Herbario Forestal, Universidad Distrital, Bogotá, Colombia*
[2]*New York Botanical Garden, U.S.A.*

The neotropical tribe Henriquezieae includes the genera *Gleasonia*, *Henriquezia* and *Platycarpum*, with a total of 19 species of trees, distributed mainly in the Guayana region. Its allies are the genera *Molopanthera*, with a single species in Brazil, and *Posoqueria*, with about 11 species of trees and shrubs widely distributed in the neotropics. Recent molecular phylogenetic analyses have shown that members of the tribe Henriquezieae are in the same clade with *Molopanthera* and *Posoqueria*, a relationship not suspected in the past, when classifications were based exclusively on morphological data. However, the sampling inside the clade has not been large enough to postulate phylogenetic relationships of its members.

The objective of this study is to expand the sampling within the clade in order to test the monophyly of the tribe Henriquezieae and that of the genera studied. In addition, this study will test the monophyly of the recently described tribe Posoquerieae. Methodology includes parsimony analysis using DNA sequence variation of three molecular markers (trnL-F, rps16, and ITS). Results show that *Henriquezia* and *Platycarpum* form a well supported monophyletic group, leaving *Gleasonia* out of the tribe Henriquezieae. Data used suggest that the sister relationship between *Posoqueria* and *Molopanthera* is poorly supported.

- Paper -

Phylogenetic relationships in *Coffea* (Rubiaceae) inferred from sequence data and morphology

Aaron P. Davis[1], Olivier Maurin[1], Michael Chester[1], Esther F. Mvungi[2] & Michael F. Fay[1]

[1]*Royal Botanic Gardens, Kew, England*
[2]*University of Dar es Salaam, Tanzania*

Phylogenetic relationships of *Coffea* and the closely related *Psilanthus* are inferred using sequence data from four plastid regions trnL-F intron, trnL-F IGS, rpl16 intron and accD-psa1 IGS, ITS of nuclear rDNA (ITS 1/ITS 2), and a morphological data set. We assess the relationships in 73 species of *Coffea* (c. 71% of total species diversity) and seven species of *Psilanthus* (c. 32% of total species diversity).

Our results infer that *Coffea* plus *Psilanthus* forms a well-supported and easily characterized clade. The monophyly of *Coffea* is unresolved; the monophyly of *Psilanthus* is weakly supported. *Coffea* subgen. *Baracoffea* and *Psilanthus* subgen. *Psilanthus* are monophyletic but *Coffea* subgen. *Coffea* and *Psilanthus* subgen. *Afrocoffea* are paraphyletic. Well supported clades corresponding to phytogeographical regions, or having geographical coherence, are recovered in *Coffea* and *Psilanthus*. Low levels of sequence divergence do not allow for complete resolution of relationships, and most notably for the species of *Coffea* subgen. *Coffea* occurring in Madagascar. The origin of well-supported clades and other species groups in *Coffea* is discussed within the context of African and Indian Ocean biogeography. The origin of *C. arabica*, as a recent hybridization between *C. canephora* and *C. eugenioides*, is supported.

- Poster -

Rubiaceae philately

Petra De Block

National Botanic Garden of Belgium, Belgium

Rubiaceae are not only prominent in most tropical vegetation types, but can also be found in many stamp collections worldwide. At the moment, I have identified 346 Rubiaceae stamps issued from 1918 onwards. They are predominantly published in tropical or subtropical countries. Africa accounts for 31.5 % of all Rubiaceae stamps, South and Central America for 18.8 %, Asia for 15 % and the Pacific and the Caribbean for 12% and 13% respectively. Europe and North America have very few Rubiaceae stamps (0.3% each).

Rubiaceae on stamps belong predominantly to subfamily Cinchonoideae (89%) and only rarely to subfamily Rubioideae (11%) although both subfamilies are ± equally rich in species (classification following Robbrecht & Manen 2006). Genera most depicted are of economical, medicinal or horticultural interest, notably *Coffea* (33.8%), *Ixora* (14.7%), *Gardenia* (14.4%), *Mussaenda* (5.6%), *Cinchona* (4.7%) and *Psychotria* (4.7%). These six genera account for almost 78% of all Rubiaceae stamps.

In total, 43 genera and 74 species are depicted, belonging to the following tribes/groups: Anthospermeae (1/1); Calycophyllae/Condamineeae alliance (3/4); CCE complex (Chiococceae s.s., *Exostema* group: 3/5); Cinchoneae (2/4); Coffeeae (2/4); Coptosapelteae (1/1); Gaertnereae (1/1); Gardenieae (4/14); Guettardeae (1/2) Hamelieae (1/1); Ixoreae (2/6); Knoxieae (2/4); Morindeae (1/1); Mussaendeae (1/6); Naucleeae (5/5); Ophiorrhizeae (1/1); Paederieae (1/1); Palicoureeae (2/2); Pavetteae (2/3); Psychotrieae (1/2); Rubieae (1/1); Spermacoceae (3/3); Vanguerieae (2/2) (number of genera depicted/number of species depicted).

Rubiaceae stamps are not easily traced since they must be located amongst thousands of flower stamps. Furthermore, price is an issue. Rubiaceae stamps range in price between one and several hundred euro. The most expensive stamp features *Ixora coccinea* and was issued in Benin in 1994. Its price is c. 3,800 EUR.

- Paper -

Phylogeny of the tribe Pavetteae (Rubiaceae)

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The tribe Pavetteae A.Rich. ex Dumortier was revived in 1984 by Robbrecht for a group of genera from the old Gardenieae-Coffeeae complex, characterized by the combination of the following characters: terminal inflorescences, relatively small drupes with one to many seeds freely surrounding the placenta, seeds with an adaxial excavation, exotestal cells with thickenings occurring along the outer tangential wall and 3-4 colporate tectate pollen grains. At that time the Pavetteae comprised c. 20 genera and 1,200 species, with a pantropical distribution. Two main groups were recognized within the tribe: those related to *Ixora* and those related to *Pavetta*. Recently, the tribe Ixoreae A.Gray (with at that time five genera: *Captaincookia*, *Doricera*, *Ixora*, *Myonima*, and *Versteegia*) was segregated from the Pavetteae s.s. based on the combined molecular-morphological analysis of the subfamily Ixoroideae by Andreasen and Bremer.

The main objectives of the present study are to test the monophyly of the Pavetteae s.s. as presently delimited (with 15 genera: *Cladoceras*, *Coleactina*, *Coptosperma*, *Dictyandra*, *Homollea*, *Homolliella*, *Leptactina*, *Nichallea*, *Pachystylus*, *Pavetta*, *Robbrechtia*, *Rutidea*, *Schizenterospermum*, *Tarenna*, and *Tennantia*) and assess the phylogenetic relationships between its genera, using DNA sequence data from two chloroplast markers, rps16 and trnT-F, and one nuclear marker, ETS. The results of the phylogenetic analyses are presented and discussed.

- Paper -

Chemotaxonomy and macroclassification of Rubiaceae

Piero G. Delprete, Rafael Choze, Rodrigo A. Silva & Carlos R. Dufrayer

Federal University of Goias, Brazil

The taxonomic significance of iridoids, indole alkaloids and anthraquinones has been tested in previous studies by using these compounds as chemosystematic markers for the family Rubiaceae. In these studies, the compounds were compared with the four-subfamily classification proposed by Robbrecht, and supplied taxonomic evidence only for three of the four subfamilies.

In the present study, data about alkaloids, cumarins, flavonoids, iridoids, quinones, saponins and therpenoids have been obtained from an extensive search of the literature published during the last five decades, and compared with a hypothetical tree of three subfamilies and tribes constructed according to the information supplied by recent molecular phylogenies. According to the present study, the three-subfamily system and several tribes are supported by the quantitative and qualitative assessments of these compounds, and a particular taxonomic significance was supplied by the iridoids, alkaloids and flavonoids.

- Paper -

Taxonomic history, phylogenetic evidence and reproductive biology of the tribe Posoquerieae (Rubiaceae, Ixoroideae)

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The tribe Posoquerieae was recently described by Delprete, based on general morphology, palynology, floral morphology and phylogenetic evidence, to include the genera *Posoqueria* and *Molopanthera*. The floral morphology of these two genera was first recognized as unique in the Rubiaceae by Schumann, by having stamens with anthers initially joined in a conical structure in the floral buds, and then bending outwards in two couples and a single stamen during anthesis. However, Schumann preferred to maintain *Posoqueria* in the Gardenieae (although recognizing its eccentric position), and *Molopanthera* in the Cinchoneae, mainly because of the leathery berries of the first and the minute capsules of the second. Bremekamp and Verdcourt, following Schumann's observations, removed *Posoqueria* from the Gardenieae, but without suggesting any position in the family, a conclusion that was maintained by Robbrecht and Puff in their revision of the Gardenieae (although Robbrecht later maintained it in the Gardenieae). *Molopanthera* was first treated as incerta sedis by Tuczaninow, then tentatively placed in the Cinchoneae by Hooker, Baillon and Schumann, transferred to the Condamineeae by Andersson and Persson, included in the "genera associated with *Portlandia*" by Robbrecht, and lately positioned in the widely circumscribed Rondeletieae (incl. Condamineeae and Sipaneeae) by Delprete.

The recent molecular phylogenies produced by Persson, Rova et al. and Cortés-B. et al. confirmed the exclusion of *Posoqueria* from the Gardenieae proposed by previous authors. In addition, the phylogenies of Rova et al. and Cortés-B. et al. positioned *Posoqueria* and *Molopanthera* as sister genera, on a well supported clade, sister to the clade of the tribe Henriquezieae, within the subfamily Ixoroideae.

In order to further support the distinctiveness of the tribe Posoquerieae, supplementary studies have been conducted, including observations of stamen morphology, pollen presentation and pollination biology of both genera, and the results are presented here.

- Paper -

Diversity among Australian *Spermacoce* species

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Spermacoce L. (Rubiaceae - Rubioideae) is a pantropical genus comprising an estimated 275 species. Until now, tropical America and tropical Africa were considered as the main centers of diversity for the genus. A nearly completed revision of the Australian *Spermacoce* species shows, however, that Australia forms a third diversity centre. Approximately 85 species are found, of which c. 70% are new to science.

Australian *Spermacoce* species are found in very diverse habitats, from cracking clay soils to sandstone and from the northern wet woodlands to the sand dunes of the Tanami Desert. They show a remarkable variation in flower, pollen, seed and fruit morphology. Key-innovations in the radiation of the genus on the continent are pinpointed (e.g., elaborate petals and elaiosomes) and it is discussed how these might explain the relative success of *Spermacoce* in Australia.

The morphological variation is also discussed in the light of available molecular data, emphasising the implications on the delimitation and characterization of genera within the tribe Spermacoceae.

- Poster -

The family Rubiaceae at the Chamela Biological Station (IBUNAM), Jalisco, Mexico

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The Chamela Biological Station, which belongs to the Instituto de Biología, UNAM (IBUNAM), covers an area of about 3,319 ha, located in the state of Jalisco, along the central Pacific coast of Mexico. As part of one of the core zones of the Chamela-Cuixmala Biosphere Reserve, the Chamela Biological Station is mainly covered by tropical seasonal low forest, one of the most characteristic ecosystems of Mexico. Within the Station, Rubiaceae is one of the five angiosperm families best represented.

This study aims to contribute to the knowledge of the Chamela Biological Station flora, to update the information about Rubiaceae diversity in the area and to produce keys and illustrated descriptions in two formats, traditional and electronic. A format for generic and specific descriptions is proposed, to be used for florulas in the two biological stations of the IBUNAM (Tuxtlas, Veracruz, and Chamela, Jalisco). The creation of an electronic key with WinClada allows one to use it with PC-compatible computers, including some "palm" and "hand held" models. In addition, this format permits to make the information available through internet, including distribution maps and pictures of the species.

The results of this work have changed the previous information about species number (27 Rubiaceae instead of 24) and the identity of several of them, like *Bouvardia sp.* for *B. lottae* Borhidi, *Diodia sarmentosa* Sw. for *Staelia scabra* (C.Persl) Standl. and *Mitracarpus villosus* (Sw.) Cham. & Schltdl. for *M. hirtus* (L.) DC. In addition, at least one species (*Psychotria*) was found to be new. Also, the study expanded our understanding of the affinities of the area with respect to other parts of Mexico, by recording species with a more northern distribution than previously reported. Hitherto, only one species with a Mesoamerican-Neotropical distribution was known.

- Paper -

A glimpse into the family tree of Loganiaceae, with a close look at *Strychnos*, using ITS sequences and their secondary structure

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Strychnos, a member of Loganiaceae, consists of an estimated 200 species that are pantropically distributed and grow as lianas, shrubs, or small trees. Past work on *Strychnos* has been focused primarily on morphology, which has resulted in its division into 12 sections. Over a hundred sequences of the internal transcribed spacer (ITS) region of the nuclear ribosomal DNA were collected from *Strychnos* and other Loganiaceae genera and aligned using the secondary structure. Using the secondary structure as an aid in alignment can be useful to confirm positional homology in areas where the primary structure is more variable between sequences. Complimentary base changes were observed and interpreted as an additional source of evidence to support the hypothesized secondary structure for the ITS 1 and 2 regions.

Parsimony and Bayesian analyses of the data showed tribe Strychneae as monophyletic, but the sister relationships between genera were unclear as they were united in a polytomy. *Strychnos* was also monophyletic, as were the African sections *Spinosae* and *Dolichanthae* within the genus. Nine *Strychnos* sections were not supported by ITS data and one monotypic section was not included in the analysis. The most basal *Strychnos* species were African and there were multiple instances of dispersal from Africa to Asia and from Africa to the Americas. The relationships among American species of *Strychnos* were not well resolved using ITS sequences. ITS structural features conserved between Loganiaceae members will be discussed.

- Poster -

Collections of Rubiaceae in Poland

Kinga Gawrońska[1], Justyna Wiland-Szymańska[1], Petra De Block[2], Piet Stoffelen[2], Joanna Pierzchalska[1], Hanna Leśniewska[3] & Krzysztof Świerkosz[4]

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In Poland c. 60 herbaria exist in connection with universities and other scientific institutions. They contain both valuable historical collections, e.g., material from collectors such as Winkler and Dinter, the original collections of which were destroyed in Berlin, and recent collections made by prominent Polish botanists, e.g., S. Lisowski. Access to Polish herbaria is difficult for researchers not working in the country and hitherto no start has been made to digitalize the herbaria. Furthermore, the wealth of the Polish collections is often underestimated and the herbaria overlooked.

In a search of prominent Rubiaceae collections in Poland, four herbaria were especially promising. The herbarium of the Warsaw University (WA) has c. 300 specimens. In Poznań, POZG herbarium contains c. 4200 Rubiaceae. They represent c. 61 genera and 106 species, originating from 27 countries, mainly from Africa. The herbarium of the University of Wrocław (WRSL) contains one especially interesting collection: the Lauterbach Herbarium. It contains c. 1.300 specimens, with at least 56 types. The collection comes from over 50 countries and contains 113 genera and 559 species. There is also a large collection of Rubiaceae in Kraków (KRAM), but only very general data were available. This herbarium contains about 10.500 specimens of Rubiaceae from all over the world.

This study is a preliminary analysis of the resources in the Polisch herbaria. Several hundred types were identified, especially from Asia and the new world. Difficulties occur due to the lack of written or electronic catalogs and to the fact that the Polish herbaria are generally understaffed. Nevertheless, they contain important collections which may be of great value to researchers from all over the world.

- Paper -

Diversity and distribution patterns of the family Rubiaceae in New Guinea

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The Rubiaceae is the second most specious family in New Guinea after the Orchidaceae. A rapid review of the family in New Guinea indicates that it is represented by about 70 genera and over 800 species. About half of the New Guinea genera show a paleotropical distribution, i.e. genera extending from Africa or India through Malesia to the Pacific, with important centres of species diversity in mainland Asia, Malesia or New Guinea.

New Guinea has seven endemic genera, and these are represented mostly by two to five species, but *Anthorrhiza* and *Dolianthus* have nine and thirteen species respectively. A number of medium-sized to large indo-pacific genera are centred in New Guinea, e.g., *Timonius*, *Hydnophytum*, *Myrmecodia*, *Neonauclea*, and *Ophiorrhiza*. Only about 16% of the genera have a cosmopolitan (1%) or pantropical (15%) distribution. *Psychotria*, with about 200 species is by far the largest Rubiaceae genus in New Guinea.

All three currently accepted Rubiaceae subfamilies (Cinchonoideae, Ixoroideae and Rubioideae) are represented by indigenous species in New Guinea. The Rubioideae is the most specious, representing about 64% of the New Guinea species, while the Cinchonoideae and Ixoroideae contribute about 19% and 17% respectively. About 62% of the Rubioideae species belong to the tribe Psychotrieae, which has some of the most specious genera in New Guinea (e.g., *Psychotria*, *Amaracarpus*, *Hydnophytum*, *Myrmecodia*). Species endemism is extremely high, perhaps as high as 80%.

- Paper -

A world checklist of Rubiaceae

Rafaël Govaerts, David G. Frodin, Markus Ruhsam, Diane M. Bridson & Aaron P. Davis

Royal Botanic Gardens, Kew, England

A widely accessible working list of known plant species is considered to be a fundamental requirement for plant conservation, and is a main objective of the Global Strategy for Plant Conservation. As part of the effort towards compiling this working list a World Checklist of Rubiaceae has been produced (www.rbgkew.org.uk/wcsp/rubiaceae). The checklist provides access to c. 620 genera, c. 13,200 accepted species names with their synonyms: some 34,000 names in total, or put another way c. 8 % of the world's flora.

Each species entry includes the full bibliographic reference (journal, volume, pages, and year of publication), synonyms (with references), and distribution. In essence it is a summary of taxonomic Rubiaceae research from Linnaeus to the present day. For the Rubiaceae specialist it provides a new, dynamic research tool for taxonomy, systematics and comparative biology.

The methods of checklist compilation are given and its role as a key resource for Rubiaceae researchers is discussed. The key features and tools of the checklist are demonstrated. The strategy for the checklist encourages open and broad participation; future collaboration and contributions are outlined with the aim of improving the checklist. An analysis of Rubiaceae diversity, within the current framework of phylogenetic relationships for the family, is given.

- Keynote paper -

A revised fossil record of the Rubiaceae

Alan Graham[1] & Steven Manchester[2]

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Fossils attributed to the Rubiaceae occur in deposits as old as the Late Cretaceous and Paleocene, and are described in over 100 publications dating from 1850. Close scrutiny of these records indicate, however, that the oldest most likely fossils are from the middle Eocene of Oregon and Washington, USA (*Emmenopterys*), and from the late Eocene of Panama (*Faramea*) and Australia (*Guettarda*, *Canthium*), representing all three subfamilies.This implies an earlier origin in the Late Cretaceous or Paleocene. There was increasing diversity and dispersal in the Oligocene, and especially in the Miocene when 19 accepted genera occur from North America to South America, the southeast Asia-Pacific area, Africa, and Europe.

The principal need currently is to verify pending Paleocene records of *Chinchonidium* (*Chinchona*, North Dakota, USA), *Galium* (Greenland), and *Psilatricolpites coprosmoides* (*Coprosma*, Chile), and to examine the several large Cretaceous megafossil floras (e.g., Anfiteatro de Tico, Argentina; Crato, Brazil; Turonian-age floras from New Jersey and Sweden, and others) for features suggesting a rubiaceous complex, or an aggregation of features suggesting presence of the family.

- Poster -

A monograph of the neotropical genus *Bonyunia* (Loganiaceae: Antonieae)

Jason R. Grant

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Bonyunia (Loganiaceae) is a genus of twelve species comprised of 2-15 m tall lowland rainforest riverside trees (*B. antonifolia*, *B. aquatica*), 20-35 m tall lowland rainforest terra firme canopy-forest-level trees (*B. magnifica*, *B. venusta*), 2-8 m tall savanna-tepui shrubs (*B. minor*), tepui-base trees (*B. excelsa*, *B. nobilis*), cloud forest trees (*B. spectabilis*, *B. superba*), and Andean rainforest trees (*B. cracens*, *B. pulchra*, *B. regalis*). These species occur in the lowland regions of the Amazon River watershed (Brazil and Bolivia), the Guayana Region and outliers (Brazil, Guyana, Venezuela, and Colombia), and the lowland regions of the Amazon-basin-facing Andes in Peru.

The leaves are opposite, entire, with many variations in shape. The flowers are 5-petaled, white turning purple, and the seeds are thin and double-winged as adaptations for wind dispersal. Taxonomically informative characters include ecology, habit, leaf morphology, the shape and vestiture of the calyx, bracts and bracteoles, and seed morphology.

In this monograph of *Bonyunia*, the following taxa are recognized: *B. antonifolia* Progel, *B. aquatica* Ducke, *B. cracens* J.R.Grant sp. nov., *B. excelsa* J.R.Grant sp. nov., *B. magnifica* J.R.Grant sp. nov., *B. minor* N.E.Br. (including *B. cinchonioides* Gleason & Standl.), *B. nobilis* J.R.Grant sp. nov., *B. pulchra* Ricketson, J.R.Grant & Liesner sp. nov., *B. regalis* J.R.Grant sp. nov., *B. spectabilis* J.R.Grant sp. nov., *B. superba* R.H.Schomb. ex Progel, and *B. venusta* J.R.Grant sp. nov.

- Paper -

Evolution of the Spermacoceae (Rubiaceae) based on plastid DNA

Inge Groeninckx[1], Suzy Huysmans[1], Claes Persson[2], Birgitta Bremer[3], Sylvain Razafimandimbison[3], Jesper Kårehed[3], Erik Smets[1,4] & Steven Dessein[5]

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In its current description the tribe Spermacoceae (Rubiaceae) unites the former tribes Spermacoceae s.s. and Mannetieae, and the *Hedyotis-Oldenlandia* group. Within this widely conceived tribe, the *Hedyotis-Oldenlandia* group has a most problematic taxonomy. The generic delimitations within the group are particularly troublesome. Some authors favour a broad concept of *Hedyotis*, placing several other genera in synonymy (*Oldenlandia*, *Kohautia*, *Houstonia*, ...), while others advocate splitting the *Hedyotis-Oldenlandia* group into many small genera.

To resolve the relationships within the *Hedyotis-Oldenlandia* group, we carried out a molecular phylogenetic study of the Spermacoceae, based on three plastid markers with the Knoxieae as outgroup. The different datasets were analysed separately as well as combined using maximum parsimony.

The resulting topologies are very similar. *Hedyotis* s.l. turns out to be polyphyletic in all trees. Several genera formerly recognized within the *Hedyotis-Oldenlandia* group are monophyletic (*Houstonia*, *Agathisanthemum* and *Arcytophyllum*), while others are paraphyletic or polyphyletic (*Hedyotis*, *Oldenlandia* sensu Bremekamp and *Kohautia*). The Spermacoceae s.s. form a monophyletic group, well nested within the *Hedyotis-Oldenlandia* group.

A morphological reinvestigation of the taxa is ongoing to find support for the many new clades and relationships detected.

- Poster -

Floral ontogeny of the Afro-Madagascan genus *Mitrasacmopsis*

Inge Groeninckx[1], Suzy Huysmans[1], Erik Smets[1,2] & Steven Dessein[3]

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Mitrasacmopsis Jovet is a herbaceous, monotypic genus of the family Rubiaceae occurring in continental Africa and Madagascar. Its only species, *Mitrasacmopsis quadrivalvis* Jovet, is restricted to high altitude regions and typically grows in rocky areas.

Members of the Rubiaceae are generally characterized by the presence of an inferior ovary. However, *Mitrasacmopsis* is cited in literature as having a semi-superior to superior ovary. Based on the presence of an apparently (semi-)superior ovary, *Mitrasacmopsis* was originally placed in the Loganiaceae-Spigelieae. Later on, the genus was transferred to the herbaceous tribe Hedyotideae within the Rubiaceae. Since then, it has always been associated with the pantropical genus *Oldenlandia* L.

To understand the gynoecial development of *Mitrasacmopsis*, its floral ontogeny and anatomy were examined using scanning electron microscopy and serial sectioning.

It is demonstrated that only in a very late fruiting stage, continued (horizontal and vertical) expansion of the ovary raises part of it above the insertion point of the persistent calyx, changing the ovary position of *Mitrasacmopsis* from basically inferior to secondarily semi-superior. This kind of secondarily semi-superior ovary is different from the secondarily superior ovaries observed in *Gaertnera*

- Poster -

Comparative genomics within *Coffea* subgen. *Coffea* (Rubiaceae)

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Coffee trees (*Coffea* subgen. *Coffea*) are all native from the intertropical forest of Africa, Madagascar and the Comoran Islands. Their chromosome base number is x = 11 and all species except *C. arabica* (2n = 44) are diploid (2n = 2x = 22).

A strong geographical differentiation was shown from results on inter-specific hybridizations involving African diploid species. DNA content per genome was estimated for a large range of species: it varies from 1.035 pg (*C. racemosa*) to 1.764 pg (*C. humilis*) from Eastern to Western Africa. The higher the difference between the genome size of the parental species, the lower the pollen fertility of F1 hybrids. This is even more pronounced when parental species belong to differentiated geographical clades.

Interspecific genetic maps revealed recombination events between the genomes tested. Moreover, GISH permits identification of the parental genomes in F1, BC1 and BC2 hybrids and suggests the presence of highly repeated sequences. Microsatellite markers obtained from genomic sequences (SSR) were designed. Fifty to 60% of them were transferable across species. Around 15 % could be used as diagnostic loci. SSR markers were also developed from EST coffee databases (EST-SSR). Of the 5534 EST unigenes detected, c. 7% include microsatellites. EST-SSRs display a higher cross species transferability than SSR markers (c. 90%).

Cloning and sequencing amplicons obtained from several species showed that: i) orthologous loci are amplified and ii) allelic variation is mainly accounted for by the repeat motif number variation. A good level of intra species polymorphism (PIC = 0.59 and 0.48 for *C. canephora*) was detected with the two types of markers. However, EST-SSRs appeared to be better markers for interspecific differentiation and support the species status of *C. liberica* and *C. dewevrei*.

Comparative mapping within the sub-genus is ongoing and could be extended to other related genera when coffee EST-SSRs prove to be transferable across the Rubiaceae family. At the same time, developing a Rubiaceae network could help to develop a set of markers useful for genetic diversity analyses and for comparative mapping. Moreover, comparative cytological studies held within this network could help us reach a

better understanding of the genome evolution for *Coffea* subgen. *Coffea* and for the Rubiaceae family.

- Paper -

Bi-reticulum in Rubiaceae-pollen: typology, relation with distyly and evolution

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The pollen morphological variation within the family Rubiaceae (Gentianales-Asterids 1) is tremendous, and the phylogenetic signal for several palynological characters was assessed at different taxonomic levels. The predominant pollen type in the family, however, is tricolporate with a perforate or microreticulate ornamentation. The apertural system in general is complex since mostly three, non-congruent apertures occur on top of each other, each situated in different layers of the pollen wall. The variation in sexine ornamentation patterns within the family is considerable, ranging from psilate, perforate, (micro)reticulate, striate, areolate, rugulate to baculate. Supratectal elements are often lacking, but, if present, show a wide array of shapes and sizes.

In the present paper we focus on taxa having pollen with a bi-reticulum or double reticulum. This is a rare sexine condition in Rubiaceae consisting of a primary reticulum and a secondary reticulum on a slightly lower plane. The secondary reticulum can be congruent with the primary one but may sometimes be reduced to granules or spines. Pollen with a bi-reticulum is mainly restricted to the tribes Spermacoceae and Coussareeae (former Coccocypseleae), both herbaceous groups belonging to the subfamily Rubioideae (sensu Robbrecht & Manen 2006). Pollen of selected species was observed with SEM and TEM in order to assess the distribution of a bi-reticulum throughout the Rubiaceae. The patterns of evolution and possible correlations with floral morphological characteristics and breeding types are analysed. The remarkable correlation with distyly is illustrated. The occurrence of a bi-reticulum in other eudicotyledonous plant families, such as Lamiaceae, is discussed in relation to our own observations.

- Paper -

Hunting for rainbows: mineral inclusions in Rubiaceae

Steven Jansen

Royal Botanic Gardens, Kew, England

Leaves of 251 specimens of Rubiaceae, representing all subfamilies and most tribes, are investigated by light microscopy to study the morphology and distribution of mineral inclusions. These observations are compared with data from literature and records of mineral inclusions in wood.

Two crystal types are very common in the family and mutually exclusive, viz. raphides and crystal sand. Raphides characterise all Rubioideae s.l.; outside this subfamily they are reported in the related tribes Hamelieae and Hillieae, as well as in a few other genera. Crystal sand is common in numerous taxa of Cinchonoideae, as well as in some tribes of Ixoroideae (Alberteae, Gardenieae, Guettardeae, and Octotropideae).

Other crystal types are less common and can be used as taxonomic markers at tribal or generic level. Prismatic crystals occur abundantly in the wood of Coffeeae. Styloids characterize several representatives of the Ixoreae besides their presence in some Psychotrieae, and the genera *Paederia* and *Crossopteryx*. Druses are found in all subfamilies, but appear to be most common in Vanguerieae, Gardenieae, Ixoreae, Rondeletieae, Coptosapelteae and Spermacoceae. The distribution of silica bodies in Rubiaceae is restricted to their inclusion in the secondary xylem of *Hallea*, *Mitragyna* and *Simira*.

- Poster -

Inversions in the cpDNA trnS-trnG region and implications on Ixoroideae sensu lato phylogeny

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The classification of the pantropical subfamily Ixoroideae s.l. has changed as a result of a series of recent phylogenetic analyses. However, the phylogenetic relationships between the major clades, formally recognized as tribes, largely remain unresolved.

A molecular study using a combination of several chloroplast DNA regions is conducted in order to investigate the relationships and to improve the understanding of the early diversification of the subfamily. One of the regions included is trnS-trnG. We have noticed a common homoplastic inversion in the trnG intron and discuss its implications on the structure and support of the phylogeny.

- Paper -

The tribe Knoxieae – a new generic classification with special emphasis on the Malagasy taxa

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The African and Indomalesian tribe Knoxieae has recently been expanded. It now also includes several former genera of Hedyotideae as well as Triainolepideae and probably also Lathraeocarpeae. We have confirmed these results by studying more genera (16 out of 19 genera) and more than two-thirds of the c. 130 species, not just a single species per genus.

Our results reveal that several genera of the expanded Knoxieae are not monophyletic. We summarise a new generic classification of the tribe and focus on its implications for the taxa on Madagascar.

The results are based on phylogenies resulting from both Bayesian inferences and Maximum Parsimony analyses of DNA sequences from two chloroplast markers, rps16 and trnT-F, and the nuclear ITS.

- Poster -

The living collections of Rubiaceae at the National Botanic Garden of Belgium

Viviane Leyman, Ann Van de Vyver, Jan Stallaert, Thierry Vanderborght, David Aplin, Elmar Robbrecht, Steven Dessein & Petra De Block

National Botanic Garden of Belgium, Belgium

The establishment of the National Botanic Garden of Belgium goes back to 1829; since then, the institute has built up and maintained important living collections. From the beginning, tropical plants formed a large part of the collection. Some 10,000 species, originating from the tropics and subtropics, are grown in the one hectare large glasshouse complex, known as the Plant Palace. Meanwhile, important research collections are mainly housed in a second glasshouse complex, not open for the general public.

In Belgium there is a longstanding tradition of Rubiaceae research. Well-known Belgian botanists such as Camille Vermoesen (1882-1922), Emile De Wildeman (1866-1947), Jean Lebrun (1906-1985), and Walter Robyns (1901-1986) studied the family. All these botanists worked at or in collaboration with the National Botanic Garden of Belgium. More recently, dynamic Rubiaceae research groups formed at the Garden and at the Catholic University of Leuven around Rubiaceae researchers Ernest Petit and Elmar Robbrecht. It is therefore not surprising that the Rubiaceae are one of the most important research collections in the living plant collection of the National Botanic Garden of Belgium.

In total, c. 260 Rubiaceae taxa are grown at present, representing close to one hundred genera. They were either collected in the wild, or received through exchange with other botanical gardens. Most of these plants flower on a regular basis and, therefore, the collection is a great resource for anatomical and ontogenetical studies.

Our long-term goal is to have at least one representative of all Rubiaceae genera (c. 650 genera). Therefore, the National Botanic Garden of Belgium actively searches to increase its collection of living Rubiaceae and is interested in exchange of plant material with other botanical gardens or receiving viable wild collected material from tropics and subtropics.

- Paper -

Towards an evolutionary scenario for the coffee family (Rubiaceae, angiosperms): further insights from a supertree

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A supertree for the Rubiaceae family was recently constructed by the authors and resulted in a new classification with two subfamilies and four supertribes. This supertree is used here for further evolutionary interpretation by a threefold set of analyses. The biogeography of the clades obtained in the supertree is summarized in terms of ten major regions, and a DIVA analysis is carried out. Statistics of the numbers of genera and species in the clades is provided to allow formal measuring of the diversification. The source trees of the supertree are dated using a calibration from fossil data.

The family probably originated in the Old World about 75 million years ago. The two problem genera *Luculia* and *Coptosapelta* go back to about the same time, already as separate evolutionary lineages.

The biogeographical history of Cinchonoideae is essentially limited to the Old World; one lineage, however, arrived and diversified in the New World c. 60 million years ago, viz. the clade containing Rondeletieae, Cinchoneae, Hamelieae, Catesbaeeae and Chiococceae. The dispersal of some other, now pantropical, groups to the New World, e.g., Gardenieae, is probably more recent.

The biogeographical history of Rubioideae is probably more complex, with several shifts between the Old and New World. This subfamily also originated in the Old World, with the Coussareeae probably being the only tribe that is restricted to the New World. Some lineages are confined to the Old World, e.g., Ophiorrhizeae, Knoxieae and Anthospermeae. Many other became pantropical, probably by dispersal events less than 50 million years ago, e.g., Psychotrieae, Palicoureeae and Spermacoceae. One clade, containing Paederieae, Putorieae and Rubieae (inc. *Kelloggia* and *Theligonum*), has transgressed from the tropics to temperate areas c. 40 million years ago; the Irano-Turanian region may have played a central role in that migration.

- Poster -

The evolution of fruit traits in *Coprosma* and the Coprosminae

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Although fleshy fruits are common in Rubiaceae, dry fruits are typical of the austral tribe Anthospermeae. However, at the tribal level, semi-fleshy and succulent drupes in the Coprosminae distinguish members of this subtribe from the two other dry-fruited subtribes in the Anthospermeae.

The greatest species diversity of the Coprosminae is in New Zealand, from which members are postulated to have subsequently dispersed throughout the South Pacific and Australasia. Similarly, the greatest radiation of *Coprosma* has occurred within New Zealand, and it is here that the greatest diversity of fruit pigmentation and correlated traits has evolved. Such a large variety of traits within one genus may reflect a number of dispersal syndromes, implying that fruit traits have diverged under selection from different guilds of frugivores, primarily birds and reptiles. Therefore, the genus *Coprosma*, and its respective subtribe Coprosminae have been used as models to explore the evolution of fleshy fruits within a predominantly dry-fruited group.

Evolutionary relationships within the southern/austral Pacific groups of *Coprosma* and the subtribe Coprosminae were inferred from sequence variation in the ITS and ETS regions of the nuclear ribosomal DNA and the rps16 intron region of cpDNA. From these hypotheses, inferences were made on the evolution of fruit traits at these two taxonomic levels. Within this predominantly dry-fruited tribe, fleshy fruits are speculated to have reappeared in the subtribe, the Coprosminae. It also seems that fruit colour is a labile trait within *Coprosma*, and has changed throughout the evolution of the genus, co-varying with vegetative and fruit traits in a manner predicted by putative dispersal syndromes within New Zealand. It is apparent that both allopolyploidy and reticulate evolution has occurred within *Coprosma*, and it is speculated that these have been potent mechanisms for generating change in plant morphology and fruit pigmentation.

- Paper -

Foliar and petiole anatomy of tribe Hamelieae and other Rubiaceae

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The tribe Hamelieae has a conflicting circumscription, and, depending on the author, includes two to eleven genera. At the same time, the tribe has a controversial position within Rubiaceae; traditionally it has been classified within subfamily Rubioideae, mainly due to the presence of raphides, but phylogenetic analysis based on DNA sequences suggest that it may be better placed within Cinchonoideae.

In this study, foliar and petiole anatomy was compared among several genera to determine whether these characters can be used to re-evaluate the circumscription and taxonomic position of the tribe. Our sample includes 13 species (from *Hamelia*, *Deppea*, *Hoffmannia*, *Omiltemia*, *Pinarophyllon* and *Plocaniophyllon*) belonging to Hamelieae sensu Robbrecht, plus representative species of tribes Psychotrieae (Rubioideae), Cinchoneae (Cinchonoideae) and Gardenieae (Ixoroideae). In total leaves and petioles of 22 species were sectioned using conventional embedding and staining methods.

All sampled species have bifacial mesophyll, paracytic stomata and simple epidermis with rectangular cells. The petiole vascular tissue has the shape of an open arch in all sampled species except for the ones belonging to Gardenieae, which have a closed arch. Only the species in Hamelieae and *Syringantha* have palisade parenchyma with one layer of cells, while the other species have two layers. *Plocaniophyllon* is the only taxon studied with phloematic fibers in primary, secondary and tertiary veins. Hamelieae, Psychotrieae and *Syringantha* have raphides and branched cells in the spongy parenchyma, while the other taxa have druses and un-branched cells. *Bouvardia* is the only genus studied that presents both raphides and druses in the mesophyll. The petiole vascular tissue presents a bundle sheath formed by parenchyma cells with tannins in Hamelieae and *Syringantha*, whereas it has raphides in Psychotrieae and lignified cells in Gardenieae.

Our results show that comparative foliar and petiole anatomy may provide additional characters to be considered in taxonomic and phylogenetic studies within Rubiaceae. There is anatomical support for the inclusion of *Syringantha* as part of Hamelieae sensu Robbrecht, while the presence of raphides and the attributes of the mesophyll allow one to understand why Hamelieae is morphologically treated as a member of Rubioideae.

- Poster -

Study of the effect of amount and type of soil salinity on plant growth and chemical properties in *Rubia tinctorum*

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University and Research Institute, Iran

In certain areas of the world, madder, *Rubia tinctorum* L., is an industrial crop. The species produces not only a red dye, it is also used to improve soil properties and reduce soil salinity.

This study was executed under greenhouse conditions. The experiment was based on complete block design in a factorial model with three replications. Treatments were made with six salinity concentrations (0%, 0.4%, 0.7%, 1.0%, 1.2% and 2% salt in soil) and three salt compounds (NaCl, Na_2SO_4 and NaCl + Na_2SO_4).

After 50 days, the surviving plants were studied in detail and following data were analysed: length of stems, shoots and roots; leaf and root weight; transpiration rates of wet and dry stems; free proline density in leaves; Na-, K- and Ca-density; RGR.

The study showed that high increases of salinity caused a considerable degree of damage to the plants. Increasing salinity caused free proline density in the leaves to increase. Also, Na-density increased and K- and Ca-density decreased. Stem growth, stem and root length, leaf area, water usage and root, shoot and leaf weight as well as RGR decreased. Plants showed different damage levels for the different salt compounds: NaCl > NaCl + Na_2SO_4 > Na_2SO_4.

Results showed that correlations between salinity and root length was low and correlations between salinity and proline average density high. Differences between the control group and the plants subjected to high salinity was significant. This study showed, however, that to a certain extant, madder is resistant to high salinity levels.

- Poster -

The effect of calcium ion on growth, electrophoretic patterns of polypeptides and accumulation of nutrient elements in madder (*Rubia tinctorum*)

Omid Massoudifar

University and Research Institute, Iran

Calcium has an important role in the resistance of plants to salt stress. In this research, the effects of different calcium salts at various concentrations were studied for madder (*Rubia tinctorum* L.) under salt stress (0, 50, 100, 200 and 300 Mm NaCl + 10 Mm Ca). The plants were grown in pots using vermiculite medium. Before applying the treatments, the plants were subjected to based nutrient solution (Hogland) for 1 week.

After nine weeks, shoot and root length, fresh weight and concentration of Na, Ca, K, Zn and Fe in plant tissues was determined using the A.B method. To assess the effect of salinity and Ca- treatment on electrophoretic polypeptide patterns, shoot and root proteins were separated on SDS-PAGE gels. All data were analyzed using full randomized plots and 1-way ANOVA.

The results show that solutions containing 5 Mm Ca and 100 Mm NaCl have the best effect on plant morphological (e.g., root and shoot length) and chemical properties (Fe, K and Zn). Comparison between polypeptide patterns of treatments show that calcium effects protein synthesis in plants under salt stress. In plants treated with 100 and 150 Mm NaCl-solutions, polypeptide bands (56 KDa) are more condensed than in the control group. Bands of polypeptide with the molecular weight of 66-175 KDa are observed in plants treated with 50, 100 and 200 Mm NaCL-solutions. These bands are not observed in plants pretreated with the calcium ion.

- Paper -

Phylogeny of *Kadua* (= *Hedyotis*): origins, biogeography, and subgeneric classification

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Kadua is a genus in the eastern Pacific Ocean that was recently segregated from *Hedyotis*. The genus is represented by twenty species in Hawaii and seven species in French Polynesia. Sequence analyses of the ITS and 5S gene regions were used to examine the phylogenetic and biogeographic relationships within the Pacific genus *Kadua*.

Results indicate that (1) there has been a single colonization of the Hawaiian Islands, likely from widespread limestone loving species of *Hedyotis* from the western Pacific, (2) there has been at least one dispersal event (an emigration) out of Hawaii to Eastern Polynesia, and (3) the present subgeneric and subspecific classifications need further modification.

Fruit morphology varies greatly in *Kadua*. It appears that fleshy drupaceous fruits have arisen two times in this genus and take advantage of two modes of dispersal (oceanic drift and bird dispersal). One species has winged capsules that seem to be adapted to wind dispersal. In general it appears that fleshy fruits are more adapted to inter-island dispersal within archipelagos and capsule fruits are better adapted for long-distance dispersal among archipelagos.

- Poster -

Diversity of *Ixora* (Rubiaceae) in the Marquesas Islands (French Polynesia)

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Ixora L. (Ixoreae) is a large pantropical genus of Rubiaceae comprising about 400 species with the greatest diversity in Asia, especially Malesia. Most species are shrubs or small trees with white, pink, orange or red entomophilous flowers and contorted corolla lobe aestivation. The ovary is bilocular, each locule with a single ovule attached peltately to the septum. The drupaceous fruits are red or purple, with usually two plano-convex pyrenes.

The Marquesas Islands represent the oldest volcanic archipelago of French Polynesia, with seven main islands: Fatu Hiva, Hiva Oa, Mohotani, Nuku Hiva, Tahuata, Ua Huka and Ua Pou. The flora of this isolated insular system consists of about 300 species of which c. 50% are endemic.

During the preparation of the Vascular Flora of the Marquesas Islands and the Flore de la Polynésie française, four new endemic species of *Ixora* have come to light, in addition to the following three species previously described from the Marquesas: *I. marquesensis*, *I. oumuensis*, and *I. spathoidea*. We present the characteristics, relationships and distributions of these *Ixora* species, significantly increasing the Marquesan rubiaceous plant diversity.

- Paper -

Morphological evolution within the giant genus *Ixora* (Rubiaceae) in the light of phylogenetic relationships

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With c. 400 species of shrubs and small trees widespread in all tropical areas, *Ixora* (Ixoreae, Ixoroideae) is one of the giant rubiaceous genera. In the light of ongoing molecular phylogenetic studies, we assessed the evolution of morphological features within the diverse *Ixora* representatives and between *Ixora* and its currently related genera: *Captaincookia* (New Caledonia), *Doricera* (confined to the Rodrigues Island), *Myonima* (restricted to the Mascarenes), *Versteegia* (confined to New Guinea and Micronesia) and *Scyphiphora* (isolated in paleotropical mangrove). The genera *Greenea*, *Aleisanthia* and *Aleisanthiopsis* (confined to South-East Asia and Indonesia), recently associated with *Ixora* based on molecular phylogenetic results, were also included.

More than 350 species of *Ixora* and related taxa were studied to evaluate the morphological variability in the group. We particularly focussed on reproductive organs such as inflorescence, flower, ovary and fruit, to improve the current generic and infra-generic classification and assess putative patterns of evolution.

- Poster -

The Rubiaceae of the Upper Basin of the Luncavăț River in the Căpățânii Mountains (Southern Carpathians)

Mariana Niculescu

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The Căpățânii Mountains are part of the Southern Carpathians, ranging between the Oltet rivulet to the East and the Olt River to the West. The highest peaks in these mountains are: Ursu (2124 m), Căpățâna (2113 m), Balota (2094 m) and Negoveanul (2064 m).

The flora and fauna in this region of the Carpathians are very rich and interesting. The high diversity of plant and animal species, some of them rare and endemic, necessitates their protection and the reduction of anthropic factors which represent a real danger to the ecosystem integrity and the biodiversity preservation.

The territory under research is located along the upper course of the Luncavăț River and it covers an area of about 450 square kilometres. From the geo-morphological point of view, the upper basin of the river includes two well-defined levels of relief: the mountain region, belonging to the Căpățânii Mountains, in the Southern Carpathians, and the Horezu SubCarpathian Depression, which is part of the SubCarpathian region of Oltenia.

In the Romanian Flora the Rubiaceae family is represented by five genera and 46 species. As a result of our botanical and phytosociological research we identified 17 Rubiaceae species in the study area, notably *Asperula cynanchica* L., *A. taurina* L., *Cruciata glabra* (L.) Ehrend. (*Galium vernum* Scop.), *C. laevipes* Opiz (*Galium cruciata* L.), *Galium album* Mill. (*G. erectum* Huds.), *G. anisophyllon* Vill., *G. aparine* L., *G. glaucum* L. (*Asperula glauca* (L.) Bess.), *G. kitaibelianum* Schultes et Schultes, *G. mollugo* L., *G. odoratum* (L.) Scop. (*Asperula odorata* L.), *G. palustre* L., *G. pumilum* Murr., *G. rotundifolium* L., *G. schultesii* Vest., *G. verum* L. and *Sherardia arvensis* L. Some of these occur frequently, while others are rare or endemic species.

- Paper -

Examination of the Rubiaceae classification according to a phylogenetic analysis of combined evidence from three genes

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In the past years a great number of nucleotide sequences for Rubiaceae species has been produced and analysed in the context of different frameworks. Nevertheless, it was not until recently that attempts have been made to analyse the vast amount of available information in combined analyses. This work aims to summarize the status of our knowledge in this respect, and to evaluate the current classification of the family using a combined analysis of three nucleotide regions.

Sequences from rbcL, rps16 and trnL were downloaded from GenBank and combined into a single matrix. The matrix includes 456 taxa representing about 300 genera (depending on whether certain controversial genera are accepted). This roughly corresponds to 50% of the genera recognized in the family.

A consensus of the most parsimonious trees was used as reference to map group membership variables following Robbrecht's latest proposal, from the family to tribal level. This method allows for a direct identification of incongruence between the consensus tree and the classification. Compared to the two previous classifications of Robbrecht, most incongruence has been resolved, but according to the combined results there is still some conflict. Changes in the classification that are corroborated by the current method and others that are still in need to be reviewed are highlighted at all taxonomic ranks. E.g., the inclusion of *Dialypetalanthus* as part of Rubiaceae and related to Calycophylleae is supported; the recognition of only two subfamilies, and the classification of *Rachicallis* as part of Rondeletieae are corroborated. Key taxa that still have conflict in this context are listed and their positions are analysed. E.g., according to the combined analysis, Ixoridinae II is not supported as a monophyletic group; the Vanguerieae alliance is paraphyletic; *Calochone* is supported as part of the Gardenieae alliance, *Diplospora* as a member of Coffeeae and *Pertusadina* as part of Cinchonidinae; Cinchonidinae II seems to be polyphyletic; the "basal Rubioideae" are paraphyletic; *Prismatomeris* is not supported as part of Morindeae; Psychotrieae could be paraphyletic with respect to Palicoureeae; Rubiidinae I is paraphyletic and Danaideae polyphyletic.

Finally, problems with the method used here are addressed. Also, a work strategy for further research and for critical analysis and integration of the results from DNA data is suggested.

- Poster -

The genus *Coussarea* (Rubiaceae) in the Atlantic Coastal Forest, Brazil

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Coussarea Aubl. comprises approximately 115 species found exclusively in the neotropics. In Brazil, the two centres of highest diversity of the genus are in the Amazon Basin and the Atlantic coastal forest, with some species endemic to each centre. The current study is of all species of *Coussarea* found in the Atlantic coastal forest and attempts to elucidate the morphological limits of the genus. To accomplish this, over 2000 specimens from 43 herbaria, as well as our own collections, were studied, including types, type photos, historical material and recent collections.

As of now, 24 species of *Coussarea* have been found to occur in the Atlantic coastal forest: *C. accedens* Müll.Arg., *C. bocainae* M.Gomes, *C. capitata* (Benth.) Müll. Arg., *C. coffeoides* Müll.Arg., *C. congestiflora* Müll.Arg., *C. contracta* (Walpert) Müll. Arg., *C. friburgensis* M.Gomes, *C. graciliflora* (Mart.) Müll.Arg., *C. hydrangeifolia* (Benth.) Müll.Arg., *C. ilheotica* Müll.Arg., *C. lanceolata* (Vell.) Müll.Arg., *C. leptopus* Müll.Arg., *C. megistophylla* Standl., *C. meridionalis* (Vell.) Müll.Arg., *C. nodosa* (Benth.) Müll.Arg., *C. procumbens* (Vell.) Müll.Arg., *C. racemosa* A.Rich., *C. speciosa* K.Schum. ex M.Gomes, *C. strigosipes* Müll.Arg., *C. triflora* Müll.Arg., *C. verticillata* Müll.Arg., *C. violacea* Aubl., *C. viridis* Müll.Arg., and *Coussarea* sp., probably a new species. Each species is described, illustrated and its distribution mapped. A key is supplied to identify the species.

- Paper -

Distribution des Gardeniinae malgaches, en particulier le genre *Hyperacanthus*

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Madagascar, par sa superficie qui est de 590,000 km^2 et par sa localisation en plein océan, est considéré comme un petit continent. Il a des affleurements géologiques très variés et des climats fortement contrastés qui ont abrités plus de 12,000 espèces, même plus, dont l'endémicité est très élevée. Les Gardeniinae malgaches, *Mantalania*, *Pseudomantalania*, *Euclinia*, *Gardenia*, *Catunaregam*, *Hyperacanthus* et *Sofikomba*, se repartissent dans toute l'île suivant leur habitat.

A l'Est, le climat est du type perhumide tempéré et la précipitation moyenne annuelle est de 2000 mm (maximum à Maroantsetra, 3700 mm), et la température moyenne annuelle est de 24°C. Cette zone correspond à une forêt dense humide sempervirente et elle abrite les genres *Hyperacanthus* avec une cinquantaine d'espèces, *Mantalania* avec trois espèces et *Pseudomantalania* avec une espèce.

A l'Ouest, le type de climat est subhumide chaud car l'humidité diminue progressivement des hauts plateaux vers la région côtière occidentale. La pluviométrie est de 500-1600 mm et la température moyenne est toujours supérieure à 23°C. La forêt dense sèche y règne, à dominance des plantes caducifoliées y compris les genres suivants: *Catunaregam* avec une ou deux espèces non décrites, *Euclinia suavissima*, *Sofikomba* (non décrit) avec trois ou quatre espèces. Cette forêt dense sèche abrite aussi des plantes à feuilles persistantes comme les genres *Hyperacanthus* avec cinq espèces, *Gardenia* avec deux ou trois espèces dont une seulement a été décrite.

Au centre, le climat passe du type humide frais à humide froid suivant l'altitude. Cependant la pluviométrie se situe entre 1200 et 1500 mm et la température moyenne est comprise entre 17 et 19°C pour le type humide frais. Plus l'altitude s'élève, plus la pluviométrie augmente (jusqu'à 1900 mm) mais par contre la température diminue (jusqu'à 0°C, même à une valeur négative); ce type de climat est humide froid suivant la classification de Koechlin. La végétation correspondante varie suivant l'altitude: forêt dense humide de moyenne altitude, suivie de la forêt dense humide de basse montagne, terminée par la fourré à *Erica* (*Phillipia* ssp.). Les Gardeniinae malgaches n'arrivent pas à croître au delà de 1400 m d'altitude. Au Sud, le climat est de type semi-aride avec une pluviométrie annuelle comprise entre 500 et 900 mm et une température moyenne

se situant entre 23 et 26°C. A l'extrême Sud (Cap Sainte Marie) jusqu'à l'extrême Sud-Ouest (Morombe), le climat est très sec de type sub-aride avec une pluviométrie enregistrée autour de 150 mm, l'humidité diminue progressivement du Sud-Ouest vers l'extrême Sud. La température moyenne annuelle oscille autour de 24°C, le maximum est à Toliara au mois de Novembre (39 à 40°C). Le fourré domine au Sud et à l'extrême Sud avec des plantes épineuses comme le genre *Catunaregam* avec une espèce, des plantes caducifoliées comme *Euclinia suavissima* et le genre *Sofikomba* avec deux espèces non décrites. Par ailleurs quelques plantes à feuilles persistantes cantonnent dans ce fourré très épineux comme le *Hyperacanthus ambovombensis*.

- Poster -

Emmenopterys henryi, one of the most strikingly beautiful trees of Chinese forests, flowering at the Arboretum of Kalmthout

Bram Rammeloo

Arboretum of Kalmthout, Belgium

Emmenopterys henryi Oliver (Rubiaceae) was discovered at the end of the nineteenth century by the famous plant hunter Ernest Wilson, who called it 'one of the most strikingly beautiful trees of Chinese forests'. The species is the sole member of the otherwise neotropical Calycophylleae/Condamineeae alliance (circumscription according to Robbrecht & Manen 2006) occurring in Asia.

Emmenopterys henryi is a large forest tree, occurring in the temperate forests of Central and SW China, as well as in the north of Birma and Thailand. It bears large inflorescences with numerous white flowers, their showiness enhanced by white semaphylls. Flowers are 5-merous, proterandrous and spread a gentle sweet smell.

This species has been cultivated in Europe since 1907 (Kew Gardens). The first flowering of the plant at Kew occurred almost seventy years later. *Emmenopterys henryi* does not flower very often as a cultivated plant in Europe. In fact, only three occurrences of flowering have hitherto been reported, one in Kalmthout in 1987. The age and origin of the specimen growing at the Arboretum of Kalmthout is unclear, although a wild origin is presumed. Almost twenty years later, the tree is flowering again. The first buds opened half August, but since flowers from a single inflorescence do not all open at the same time, flowering is expected to last at least one month.

The ongoing destruction of vast surfaces of forests, to make room for a growing agricultural sector in China, Birma and Thailand, places *Emmenopterys henryi* under serious threat. Ex-situ conservation of this beautiful species is therefore a must.

- Poster -

Revision of the tribe Hymenodictyeae (Rubiaceae, Cinchonoideae)

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The tribe Hymenodictyeae Razafim. & B.Bremer, a paleotropical group in the predominantly Neotropical subfamily Cinchonoideae of the coffee family (Rubiaceae), is revised here. Hymenodictyeae has been shown to be sister to the mostly paleotropical tribe Naucleeae and can easily be distinguished from the other Cinchonoideae tribes with capsular fruits by its stipules bearing large deciduous colleters on the margins, its valvate corolla aestivation, and its lenticellate capsular fruits containing elongate, bilaterally flattened, and accrescent placentae.

The tribe as currently circumscribed contains two genera, *Hymenodictyon* Wall. and *Paracorynanthe* R.Capuron ex J.-F.Leroy. *Hymenodictyon* is distinct from *Paracorynanthe* by its simple or compound spicate, racemose or thyrsoid inflorescences and corolla lobes without any appendages rather than compound umbelliform inflorescences and corolla lobes prolonged by ciliate appendages topped by glabrous clubs. We recognize the two described species of *Paracorynanthe* and 22 *Hymenodictyon* species, including four new species (*Hymenodictyon antakaranensis* sp. nov., *H. epiphyticum* sp. nov., *H. madagascaricum* sp. nov., and *H. tsingy* sp. nov.). A full taxonomic treatment, keys, and distribution maps of all recognized *Hymenodictyon* and *Paracorynanthe* species are provided.

- Paper -

Using combined ETS-ITS phylogeny to test morphological concepts of genera in the dioecious group of Vanguerieae (Rubiaceae)

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The dioecious group of the paleotropical tribe Vanguerieae in the subfamily Ixoroideae (Rubiaceae) comprises c. 110 species of shrubs and small trees, which are classified in eight genera: *Canthium* (the African *Canthium* subgenus *Bullockia*), *Pyrostria* (confined to Madagascar, Mascarenes, and mainland Africa) and its six allied genera, *Cyclophyllum* (confined to Australia, Pacific, and probably Southeast Asia), *Leroya*, *Neoleroya*, and *Pseudopeponidium* (all endemic to Madagascar), *Peponidium* (endemic to Madagascar and with only one species on the Comoro Islands), and *Scyphochlamys* (endemic to Rodrigues Island, Mauritius). The present generic classification of the dioecious group is based on a combination of characters such as the presence of persistent paired bracts enclosing the young inflorescences, the sexual system, and the number of locules.

We sampled 70 taxa representing all genera in the dioecious group and the Malagasy *Canthium* and sequenced both the external and internal transcribed spacers (ETS and ITS) to test the monophyly and phylogenetic relationships of these genera. The results of the phylogenetic analyses are presented and discussed.

- Paper -

A phylogenetic study of the *Rondeletia* complex (Rubiaceae: Rondeletieae) using rDNA ITS, rps16, and trnL-F sequence data

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In the present study a molecular phylogeny of the *Rondeletia* complex (Rubiaceae, Rondeletieae) was constructed, using selected representative species, with the following main objectives: 1) to evaluate the sections of *Rondeletia* proposed by Fernández, 2) to test if *Stevensia* belongs to the Rondeletieae s.s. (sensu Rova et al. 2002), and more specifically to the *Rondeletia* complex, 3) to check if ITS data from Rondeletieae support previous phylogenetic results from trnL-F data regarding circumscription of Rondeletieae, and 4) to verify if *Hodgkinsonia* belongs to Guettardeae or not.

Two analyses were performed, one with ITS sequences from 46 taxa in the Rondeletieae-Guettardeae complex, and the other with combined ITS, rps16, and trnL-F sequences of 21 taxa. Representatives of nine out of the ten sections of *Rondeletia* recognized by Fernandez were included in the ITS analysis. Five of her sections could be tested for monophyly. Support was only found for section *Leoninae*, but the *Rondeletia* representatives from sections *Chamaebuxifolia*, *Hypoleucae* and *Nipenses* together form a well supported clade that could be distinguished also based on morphology. Their closest relative is *Stevensia*, which is thus placed within *Rondeletia* s.s. In addition, ITS sequence data support the separation of *Rovaeanthus* from *Rogiera*. Support is low for inclusion of *Blepharidium*, *Mazaea*, *Phyllomelia*, *Rachicallis*, part of *Rogiera*, and *Suberanthus* in Rondeletieae. *Rachicallis*, *Mazaea*, and *Phyllomelia* form a clade with strong support. The tribe Rondeletieae s.s. was found to be monophyletic in all trees, but with low support. The monophyly for the tribe Guettardeae is only weakly supported, with the inclusion of *Arachnothryx*, *Cuatrecasasiodendron*, *Gonzalagunia*, *Hodgkinsonia*, and *Timonius*.

- Poster -

Rubiaceae phylogeny based on rps16 sequence data

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DNA sequences from the chloroplast rps16 intron were analysed cladistically (Jackknife, 1000 replicates) for 193 Rubiaceae and 7 outgroup taxa. Emphasis was put on the tribes Calycophylleae, Catesbaeeae, Chiococceae, Condamineeae, Guettardeae, Hippotideae, Rondeletieae, and Sipaneeae.

Calycophylleae, Condamineeae, and Hippotideae are closely related within Ixoroideae. *Bothriospora*, *Dolicholobium*, *Macrocnemum*, *Mastixiodendron*, *Scyphiphora*, and *Semaphyllanthe* are placed in this tribal complex. Sipaneeae is a tribe in subfamily Ixoroideae. *Aleisanthia*, *Aleisanthiopsis*, *Augusta*, *Greenea*, and *Wendlandia* are related to Vanguerieae and Gardenieae in subfamily Ixoroideae. *Sabicea* and *Virectaria* form a clade, as do *Molopanthera* and *Posoqueria*. *Chione* is found to be the sister group to a Hamelieae-Hillieae clade, and a close relationship between this clade, and *Strumpfia* and Catesbaeeae is indicated. *Isertia* and *Kerianthera* form a clade. *Hymenodictyon* is closely related to a widely circumscribed Naucleeae. A broadly defined Catesbaeeae is supported, including *Asemnantha*, *Catesbaea*, *Ceratopyxis*, *Chiococca*, *Coutaportla*, *Coutarea*, *Cubanola*, *Erithalis*, *Exostema*, *Hintonia*, *Isidorea*, *Phialanthus*, *Portlandia*, *Schmidtottia*, *Scolosanthus*, and *Siemensia*. *Exostema* s.l. is polyphyletic. *Bobea* is found basal in a clade including Rondeletieae and Guettardeae. There is no support for Guettardeae sensu Rova et al. 2002. *Guettarda* is found in a well supported clade including also *Antirhea*, *Malanea*, and *Neolaugeria*. *Cuatrecasasiodendron* is closely related to *Arachnotryx* and *Gonzalagunia*. Rondeletieae in a restricted sense is well supported and would include *Acrosynanthus*, *Blepharidium*, *Mazaea*, *Rachicallis*, *Rogiera suffrutescens* (Brandegee) Borhidi, *Roigella*, *Rondeletia*, and *Suberanthus*.

- Poster -

Phylogeny, diversity and biogeography of four tribes within Rubioideae

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Subfamily Rubioideae comprises the sister groups *Psychotria* alliance and Spermacoceae alliance, and in addition four basal tribes that form successive sister groups to the *Psychotria*-Spermacoceae alliances: Ophiorrhizeae including eight genera mainly distributed in South East Asia, Urophylleae, twenty one genera with pantropical distribution, Lasiantheae, four genera mainly in the old world tropics and Coussareeae, nine genera mainly in the neotropics.

This recently initiated project involves phylogeny, biogeography and character evolution within these tribes. Initially, we investigate relationships between the approximately 1,350 species assigned to the tribes, using molecular data. The resulting phylogenies will provide a framework for estimates of divergence times and hypotheses on evolutionary and ecological mechanisms behind morphological variation, species richness and geographical patterns.

- Poster -

Biotaxonomic studies on the genus *Staelia* (Spermacoceae, Rubiaceae)

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Staelia Cham. & Schltdt. is an American genus consisting of herbs or suffrutices. It differs from the other genera of the Spermacoceae by its fruits, which are dehiscent in three parts, two apical caducous pieces and one basal persistent piece.

The genus consists of c. 14 species. Ten species, eight of which are endemic, occur in Brazil. The others are distributed in Argentina (2 species), Paraguay (2 species), Uruguay (2 species) and Bolivia (2 species).

The taxonomic revision of the genus *Staelia* resulted in the description of five new taxa. Also, new combinations were made, new synonyms established and known geographical areas expanded. The present study further comprises an analysis of exomorphological, palynological and chromosome data. The pollen morphological study revealed uniformity in form, sculpture and structure of the pollen in most of the taxa. The chromosome numbers are consistent with the basic number reported for the tribe Spermacoceae.

- Paper -

Ophiorrhiza and satellite genera – relationships and biogeography

Ivan A. Schanzer

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The genus *Ophiorrhiza* is distributed throughout E India, SE Asia, and Malesia to W Pacific. Though usually estimated to comprise about 150 species, it has more than 400 species actually described, a handful of which has been synonymised so far. Assessment of infrageneric relationships has never been attempted.

Cladistic analyses of a matrix of 112 taxa and 80 morphological characters with *Xanthophytum involucratum* as outgroup reveal that the genus may be subdivided into 4 to 7 major provisional groups. Satellite genera sometimes included in *Ophiorrhiza*, viz. *Polyura*, *Klossia*, and *Notodontia*, appear to be sister to the rest of *Ophiorrhiza* in some of the analyses, but are scattered among different clades in others. Most of the characters used in the analyses appear to be homoplasious, thus groups defined can be characterized by character combinations only. The resulting trees are all weakly supported and with low consistency indices due to homoplasy. The position of a number of taxa remains uncertain in all of the trees. However, the major groups defined can be characterized from both morphological and biogeographical points of view and are probably natural, at least partly. For example, the *O. umbricola* group (*O. umbricola*, *O. ripicola*, *O. ixora*, *O. nutans*, *O. succirubra*, *O. longifloriformis*, *O. longiflora*, *O. bracteata*, *O. cantoniensis*) as defined by most of the analyses is well characterized by the peculiar combination of inflorescence, bract, and flower characters, and is vicariously distributed from N Burma and SW China to Indo-China and W Malesia. Molecular data can probably better resolve relationships within the genus.

- Paper -

Distribution patterns of rheophytes within Rubiaceae in Cameroon

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Rheophytes are plant species which are confined to the beds of swift-running streams and rivers and grow there up to flood-level, but not beyond the reach of regularly occurring flash floods. They belong to a distinct biological group of plants, ranking at the same level with epiphytes, parasites, saprophytes, therophytes, xerophytes, myrmecophytes, etc. They also occupy a specialized biological niche in nature.

Studying the literature it became clear that rheophytes occur all over the world and primarily in the tropics. Unfortunately, not much attention has been given to this important group of plants in tropical Africa. The purpose of this contribution is to produce a checklist for Cameroon of the rheophytes belonging to the Rubiaceae. For each taxon, the distribution pattern and status of conservation is given.

- Poster -

Palynotaxonomy of South American species of *Mitracarpus* (Rubiaceae – Spermacoceae)

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Pollen morphology of 21 South American species of *Mitracarpus* Zucc. ex Schult. & Schult.f. was investigated using scanning electron (SEM) and light microscopy (LM).

The genus can be classified as eurypalynous, with small to medium sized pollen grains. The polar axis varies in length from 15 µm to 35 µm, the equatorial axis from 17.5 µm to 37.5 µm. Pollen grains are colpate or colporate, with 4-10 equatorial apertures (zonoaperturate). The endoapertures are difficult to observe under LM, mostly being lalongate. *Mitracarpus brasiliensis* was the most variable in terms of the number of apertures: between five and nine, with the 6-colpate type most represented (83%). *M. longicalyx* and *M. parvulus*, 4-5 colpate, were the least variable. A colpate apertural type is more frequent in species with basic number of apertures 4-6.

Exine layers were clearly defined, always with the sexine thicker than the nexine. Supratectal elements, such as granules and/or microspines were observed. The internal surface of the nexine is granular, and frequently exhibits irregular endocracks.

Amongst the studied South American species of *Mitracarpus*, it was also possible to observe correlated characters that strengthened the establishment of species groups, mainly taking into account the ornamentation of the exine and the apertural types: (1) tectate/colpate (*M. longicalyx*), (2) perforate/colpate (*M. hirtus*, *M. eritricoides*, *M. microspermus*, *M. parvulus*, *M. pusillus*, *M. scabrellus*, *M. steyermarkii*, *M.* sp.2 and *M.* sp.3), (3) perforate-micoreticulate/colporate (*M. anthospermoides*, *M. lhotzkyanus*, *M. megapotamicus*, *M. rigidifolius* and *M.* sp.4), (4) microreticulate/colporate (*M. brevis, M. discolor* and *M. eichleri*) and (5) reticulate/colporate (*M. frigidus*). Amongst such paired characters we can highlight colpate pollen with tectate (both imperforate and perforate) sexine (but pollen grains of *M.* sp.1 are perforate/colporate), and colporate pollen with reticulate or microreticulate sexine (but *M. brasiliensis* has reticulate/colpate pollen grains). Also, colporate pollen grains are larger than colpate ones. We therefore expect that this study will add valuable taxonomic characters for the ongoing studies in the genus.

- Paper -

Molecular phylogenetics of *Galium* (Rubiaceae)

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The genus *Galium* is a member of the tribe Rubieae, characterized as herbs with whorls of leaves and leaf-like stipules, and comprised of at least 400 species distributed worldwide. Approximately thirteen genera are included within Rubieae and previous molecular phylogenetic analyses within the tribe support the monophyly of Rubieae, but indicate paraphyly of *Galium*. Relationships within *Galium* and its related genera remain poorly understood, and require more extensive sampling and use of additional regions of DNA to elucidate interspecific relationships.

Over 150 taxa across 9 genera within the tribe have been sampled to develop a framework molecular phylogeny for *Galium* and related genera and for finer taxonomic scales within *Galium*. Several non-coding regions of chloroplast DNA that are being used include the intron and intergenic spacer regions of trnT-trnF, rpoB-trnC intergenic spacer, and the trnC-ycf6-psbM intergenic spacer regions. Our results confirm previous analyses showing *Galium* as paraphyletic, with some species forming two clades with members of the genus *Asperula*, and other species of *Galium* forming a clade with three other genera, *Cruciata*, *Relbunium* and *Valantia*. Our results indicate a well-supported clade of taxa from sections *Baccogalium*, *Lophogalium*, and *Platygalium* and the genus *Relbunium*. This clade will be sampled more extensively and examined to develop a well-resolved, fine-scale phylogeny that will be used to examine breeding system evolution in a clade exhibiting hermaphroditism, dioecy, and mixed breeding systems.

- Poster -

Distribution of Rubiaceae along an altitudinal gradient in São Tomé and Príncipe

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The distribution of indigenous Rubiaceae in relation to altitude was surveyed in the islands of São Tomé and Príncipe (Gulf of Guinea). Fifty five species of Rubiaceae have been recorded in São Tomé and 31 in Príncipe. Of these, 42% and 19%, respectively, are endemic. These figures constitute an underestimation as a few undescribed species were not taken into account. Even so, these rates of endemism are considerably higher than those calculated for the whole flora (Spermatophyta) of the islands, which are 14% and 12% respectively.

Out of the 678 herbarium specimens of Rubiaceae collected in the archipelago and databased, 556 were suitable for analysis. These specimens correspond to 69 taxa, of which 31 are endemic to at least one of the four islands of the Gulf of Guinea. Each specimen was localized using a gazetteer of the collection localities of São Tomé and Príncipe. Identical specimens from the same localities were grouped. For each locality, GIS was used to interpolate the altitude and the localization with regard to conservation policies, i.e. within a national park, its buffering zones or outside protected areas. Each species was then classified according to its altitudinal distribution and conservation status.

In a second analysis, we established the flora of each interval of 100 m of altitude for the two islands (20 intervals in São Tomé, 7 in Príncipe). Detrended Correspondence Analysis (DCA) was used to determine the main gradients in the distribution of Rubiaceae in the classes of altitudinal interval. For each interval, we calculated specific richness and endemism rate, the latter calculated as the number of endemic taxa divided by the number of taxa for this interval.

Eighty-eight percent of the taxa are lowland species (under 800 m), among which 29 % have broad altitudinal ranges (from 0 to 2024 m) and 24 % are submontane transgressors (from 0 to 1400 m). Three taxa are strictly montane (above 1400 m) and four are submontane (between 800 and 1400 m). Endemic taxa mainly show a broad altitudinal distribution (39 %), while other taxa are mostly restricted to low altitudes (43 %). Most of montane or submontane species are endemic. DCA revealed that the main ecological gradient is best explained per island. On each island, the main gradient is correlated

to altitude. Specific richness of each altitudinal interval decreases with altitude while the rate of endemism increases. These results support the theory according to which the flora of São Tomé and Príncipe originates mainly from the lowland forest of the continent. Speciation occurred from mid to high altitude resulting in an increase of endemism with altitude.

Nearly 50 % of the 69 taxa (45 % of the endemic species and 53 % of non endemic) can be considered as not endangered because they are widespread in the archipelago. They were collected in the Obo National Park, its buffer zone and the non protected part of the islands. Twenty-nine of the 31 endemic taxa were collected at least once inside the National Park. Two taxa, *Aulacocalyx pallens* subsp. *pallens* (six specimens) and *Sabicea thomensis* (one specimen) were only recorded within the buffer zone of the National Park. This zone is under intensive human pressure, mainly deforestation for agricultural practises.

- Poster -

Description of new *Coffea* taxa confirms that Central Africa is an important centre of diversity for coffee breeding

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Coffea anthonyi sp. nov. ined. was collected in Cameroon and Congo. The species has strong relationships with *C. eugenioides* and the allotetraploid species *C. arabica*. As such, it could be related to a progenitor species of *C. arabica*. The new species is self-compatible, a rare character within the genus *Coffea*. Therefore, this new species is very interesting, as well from a phylogenetic as from a breeding point of view.

The occurrence of *C. anthonyi* in Cameroon and Congo confirms the presence of an important diversity centre for coffee in Central Africa. Until recently, its richness in coffee species was underestimated. For Cameroon nine new species were described recently, bringing the total number of *Coffea* species to 13 for Cameroon and 17 for Central Africa. Additional to this number of species, a few poorly known taxa are not yet formally described. In terms of species richness and diversity Cameroon and the bordering regions is as important as Tanzania (16 species).

Important traits for coffee breeding have been discovered in species from Central Africa and especially from Cameroon and Gabon, such as the self-compatibility of *C. anthonyi* and *C. heterocalyx*, and the caffeine-free beans of *C. charrieriana*.

- Paper -

Towards a treatment of the Rubiaceae for 'Flore d'Afrique Centrale'

Piet Stoffelen[1], Sofie De Smedt[1], Steven Dessein[1], Inge Groeninckx[2], Petra De Block[1], Henry Engledow[1] & Elmar Robbrecht[1]

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In 2003 two digitization projects commenced at the National Botanic Garden of Belgium. The first, the Albertine Rift Project, was a pilot study partly financed by the European Network for Biodiversity Information with as principal aim access to Albertine Rift biodiversity data. The Rubiaceae were chosen as test group, representing plant diversity within central Africa. Representative specimens for each taxon within this family, occurring in Rwanda, Burundi and the eastern parts of the Democratic Republic of Congo, were selected, digitally scanned and databased. This resulted in the digitization of approximately 3,000 specimens representing 272 taxa. The results may be accessed online (http://projects.bebif.be/enbi/albertinerift/common/home).

The second project comprised the digitization of African type specimens, as part of the African Plant Initiative, financed by the Andrew Mellon Foundation. For Rubiaceae at present, more than 1,300 nomenclatorial type specimens, representing more than 800 taxa within the family, have been digitized.

These two projects have contributed greatly to the digitization of the herbarium collections of Rubiaceae from the Democratic Republic of Congo, Rwanda and Burundi. At present, approximately 13,000 specimens, constituting some 876 taxa, have been databased. A specimen-based checklist of the Rubiaceae for the region is also produced. All this provides a firm foundation for the treatment of the family in 'Flore d'Afrique Centrale' and the creation of an online digital flora.

- Paper -

Spatial evolutionary and ecological vicariance analysis of biodiversity – a new interdisciplinary approach with an example from neotropical Gentianaceae

Lena Struwe, Richard Lathrop & Peter Smouse

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The tropics are a conglomerate of regions with different environments, age, geology and climatic history. A new method called Spatial Evolutionary and Ecological Vicariance Analysis (SEEVA) is presented. It integrates evolutionary hypotheses, ecological history, geographic distribution, and the geologic record to better understand speciation patterns and processes.

The method is dependent on three basic sources of data; 1) revisions and georeferenced locality information, 2) well-supported phylogenetic hypotheses including all species of the study group, and 3) environmental data extracted from GIS base layers. A statistical method has been developed to evaluate unlimited numbers of environmental variables for their correlation (non-randomness) with species distributions across georeferenced collections, either by clade (historical time-based) or by current species (extant-based). Relative, standardized impact for different environmental and ecological factors can be evaluated throughout the history of the study group and compared with the geologic history.

An example from the Neotropics using the plant family Gentianaceae will be presented. It utilizes all-species-inclusive phylogenies of genera based on molecular and morphological data, herbarium records, and GIS analyses of base layer data from a variety of sources.

- Poster -

Biogeographic patterns in neotropical Rubiaceae

Charlotte Taylor

Missouri Botanical Garden, U.S.A.

With checklists and floras now available for an increasing number of regions, biogeographic patterns within Rubiceae are becoming clearer. Lists of genera and tribes and numbers of species per genus of native Rubiaceae were compiled for Mesoamerica, the Greater Antilles (excluding Jamaica), Ecuador, Bolivia, the Venezuelan Guayana, the Flora of East Tropical Africa region (Uganda, Tanzania, Kenya), Sub-Saharan Tropical Africa, and generalized tropical South America.

Taxa per area are compared using log-log scaling, showing that some areas are in fact basically more diverse in Rubiaceae species and lineages than others. Floristic similarities among areas, based on shared genera and tribes, are calculated using Sørenson's Index and show that in general biogeography is more important than ecology in composition of the Rubiaceae flora. Diversification within genera and tribes for each region was estimated using rarefaction. As more regional floras are compiled, the patterns in Rubiaceae diversity will become clearer. The patterns provide much information about the drivers of diversity in this group. The Rubiaceae are numerous in most tropical regions and thus the drivers of Rubiaceae diversity are no doubt the same as for many other plant groups.

- Poster -

The Rubiaceae flora of China

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The Chinese treatment of the Rubiaceae was published in 1999 by Lo et al. As part of the international Flora of China project, this treatment is being translated to English and updated by T. Chen, C.M. Taylor, and Collaborators.

The Rubiaceae known from China so far comprise 92 native genera with about 660 species, plus 3 naturalized neotropical genera and 5 cultivated non-native genera. *Theligonum* is included in Rubiaceae here; *Silvianthus* and *Carlemannia* were included by Lo et al. but are excluded here. Most of the Chinese genera are tropical and shared with Thailand, and most are so far known from only 1 species in China. At least 3 genera have been added to the Chinese Rubiaceae flora since Lo et al.'s treatment. Genus and species diversity known so far are generally mapped by province. The Chinese Rubiaceae flora is compared with the North American Rubiaceae.

- Paper -

Phylogenetic relationships within *Tricalysia* related genera

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Recent studies by Davis et al. on the circumscription of the tribe Coffeeae revealed a weakly supported clade containing *Tricalysia* and allied taxa, namely *Argocoffeopsis*, *Calycosiphonia*, *Belonophora*, *Diplospora*, *Discospermum*, *Nostolachma* and *Xantonnea*. The phylogenetic relationships of *Tricalysia* and related genera are investigated further using sequence data from 4 plastid regions (trnL-F, rpL16, accd-psa1, trns-fm) and nuclear ribosomal ITS data.

In particular, the investigation focuses on the intra-generic relationships within the Afro-Malagasy genus *Tricalysia*. This is the first study to test the monophyly of the two subgenera of *Tricalysia* (subgenus *Tricalysia* and subgenus *Empogona*). Thus far, few studies have included representatives of both subgenera. This study incorporates taxa from both sections of subgenus *Empogona* (sections *Empogona* and *Kraussiopsis*) and four of the five sections of subgenus *Tricalysia* (sections *Ephedranthera*, *Probletostemon*, *Tricalysia* and *Androgyne*). The monophyly of the Malagasy taxa is also tested.

The low level of genetic divergence between taxa prevents complete resolution of relationships within *Tricalysia*. These initial results are interpreted in terms of the biogeographic history of the genus.

- Poster -

Rubiaceae diveristy and the living collections at the National Botanic Garden of Belgium

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The Rubiaceae is the fourth largest angiosperm family and comprises c. 12,000 species and 650 genera. The family members are very diverse in their habit and architecture while vegetative and reproductive morphology is also variable. The variation in floral biology is enormous, with certain groups having secondary pollen presentation, heterodistyly or unisexuality. The study of this diversity is often limited when only herbarium material is available. Therefore, it is paramount for research that Rubiaceae plants are grown in glasshouses in botanical collections.

In the National Botanic Garden of Belgium c. 260 Rubiaceae taxa, belonging to c. 100 genera are grown under glass. Most flower regularly. In an effort to maximize the benefits of this collection, a survey and collecting strategy has been implemented. The living Rubiaceae were grouped as much as possible and the collection visited weekly. When plants are in flower and fruit, herbarium specimens are collected. Using these new specimens, identifications can be updated. Other collections made include dry leaf material for molecular studies and pickled samples from leaf, flower and fruit parts, enabling anatomical or ontogenetical studies that follow different developmental stages. Photographs are also taken of all taxa.

This poster aims to celebrate the diversity and beauty of this fascinating floral group with pictures from plants grown at the National Botanic Garden of Belgium.

- Paper -

The development of pollen, tapetum and orbicules in Rubiaceae

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An overview will be presented of our current knowledge on the development of pollen, tapetum and orbicules in Rubiaceae species. Earlier studies on the pollen and tapetum development in Rubiaceae (*Mitriostigma* and *Rondeletia*) will be compared with our own studies in *Tarenna*. This research is based on light (LM), scanning electron (SEM), and transmission electron microscopic (TEM) observations, complemented by the cytochemistry of developing anthers from the microspore mother cell stage until anther dehiscence.

A callose wall envelopes the young microspore tetrads and is enzymatically digested by callase at early free microspore stage. In Rubiaceae, tectum, columellae and foot layer develop centripetally in a glycocalyx matrix, which is a common feature in angiosperms. A single white line appears near the plasmalemma in the extra-apertural regions at late tetrad stage from which the endexine originates. The developing endexine dilates into several white line centered lamellae at the apertural regions. Subsequently, the development of a membranous granular layer (MGL) is obvious in *Rondeletia* prior to intine formation. Its mode and timing of development and its chemical composition clearly indicate that it is different from endexine or intine. The mature intine can be composed of a single or two strata. In Rubiaceae species amoeboid as well as secretory tapeta are reported. Cycles of hyperactivity and protrusions of the tapetal cells into the locular cavity during pollen development are also reported. Orbicules are commonly produced by secretory tapetal cells. Sporopollenin deposition on the pre-orbicules is shown to be extracellular and mediated by white lines indicating correlations with endexine formation. Our data allow us to determine common patterns in pollen wall and orbicule development in Rubiaceae which can be generalized to Gentianales.

- Paper -

A species-level classification of Chinese *Hedyotis*

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The genus *Hedyotis* L. sensu lato (Rubiaceae) includes about 600 species, distributed mainly in tropics and subtropics, especially with a very high diversity in the old world. They can be easily recognized by having opposite and entire leaves, dentate to fimbriate or divided stipules, 4-5-merous hermaphrodite and often heterostylous flowers, 2-celled ovaries with many ovules in each locule, dehiscent or indehiscent capsules with many angled seeds.

The classification of Chinese *Hedyotis* is preliminary revised here. A broad concept of the genus is applied, including both *Hedyotis* L. sensu stricto and *Oldenlandia* L.

Morphological characters are examined and evaluated in this study. Some reproductive characters are useful for delimiting broad species groups, viz.: the characters of flowers, the arrangement of the inflorescence and the shape, size and texture of the capsules. Besides, the shapes and/or indument of stem, leaf, stipule and calyx are also diagnostically valuable vegetative characters.

It was revealed that 65 *Hedyotis* species and nine varieties are distributed in China, including six species and four varieties that are new for science. Ten names were merged as synonyms. Certain problematic species complexes, such as *H. corymbosa-H. pseudocorymbosa*, *H. hermaniana-H. racemosa*, *H. mellii-H. matthewii*, need to be investigated further based on diverse methods.

- Poster -

Rudgea for the Flora of Bahia

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The neotropical genus *Rudgea*, with c.170 species ranging from Mexico to Argentina, has as its closest relative the African genus *Chazaliella* from West Tropical Africa. In Eastern Brazil, *Rudgea* is well represented especially in the Atlantic forest, where the 28 species in Southeastern and Southern Brazil were recently revised, with a considerable number of new synonymies.

Surprising diversity in the genus has been recently discovered in the Northeastern state of Bahia, formerly thought to have less than ten accepted species. Range extension for several Southeastern species was increased and five probable new taxa were discovered. Threats to the habitat unfortunately mean that many of these species are endangered, and IUCN categories are attributed to them.

Visit to Leuven

Leuven is situated on the important axis Oostende-Brussel-Leuven-Liège-Köln.The town covers an area of 14,371 acres and consists of the following boroughts: Heverlee, Leuven, Kessel-Lo, Wilsele and part of the former municipalities: Wijgmaal, Korbeek-Lo and Haasrode. It has c. 88.500 inhabitants.

A short history – The first references to the town can be traced back as far as the 9th century. In spite of its strategic location on the river Dijle, it was not until around the 11th-12th century that Leuven began to develop as an important trading centre within the Duchy of Brabant. It was at this time that its first town wall, churches, monasteries and abbeys were built.

The town's once flourishing cloth trade had fallen into decline by the 14th century, but a new golden age dawned with the 15th century. The university was founded, various industrial concerns flourished and the main market square with its fine Gothic town hall was laid out.

The finely sculpted Town Hall and Saint Peter's church with its magnificent interior which is hung with the famous 'Last Supper' by Thierry Bouts, are fine examples of flamboyant Gothic architecture at its best. Dating from the same period are the Cloth Hall, 't Sestich House and many churches, including Saint Gertrude's with its magnificent choir stalls.

The 13th century beguinage complex has cobbled streets and fascinating 17th century houses.

The Baroque style abounds in Leuven, from Saint Michael's church and the interior of the Saint John the Baptist's church to the unrivalled stucco of the Park Abbey. Both the Park Abbey and the Arenberg Castle are exciting mixtures of architectural styles. The town still owes much of its character to the numerous university college buildings dating from the 16th and 17th centuries, many of which were renovated in the 18th century. The Van Dale College is pure Renaissance style and the College of the Falcon, Pope's College and the Arras College are neo-classical style. The building of paved roads and the canal in the 18th century together with the expansion of the brewery

created a great impetus for trade and population growth. Unfortunately, this prosperity came to a sudden end under the reign of Joseph II when the French invaded.

The most significant development for Leuven in the 19th century was the building of the railway station and the construction of the Bondgenotenlaan leading to it. The two World Wars in the 20th century destroyed much of Leuven and a great deal of the reconstruction work lasted well into the nineteen-sixties.

Leuven has developed into a well-equipped, modern town with a thriving service industry economy and with a good balance of old and new buildings. When on January 1st 1995, the former province of Brabant was split into Flemish and Walloon Brabant and the metropolitan region of Brussels, Leuven became the capital of the province Flemish Brabant.

Open air museum – During a 2-hours walk we will visit the most beautiful spots of Leuven. Apart from the impressive Town Hall and Saint Peter's church, you will see the old market, the greatest bar of Western Europe', the small and great beguineage, several churches, …

Beer and chocolate – Belgium is famous for its beers. Therefore, our Leuven trip also goes to one of Belgium's most famous beer breweries, Stella Artois.

The history of Stella Artois is closely connected with the history of Leuven. The foundation of the university of Leuven in 1425, the digging of the canal Leuven-Rupel in the 18th century, two industrial revolutions and two world wars; all were events that played a fundamental part in the development of this beer town and ... of the brewery Artois. When the name of the brewery 'Den Horen' (the Horn) turns up for the first time in the ducal levy records (1366) it marks only the beginning of a brilliant success story, because in 1537 this brewery had already developed into the most important enterprise in Leuven. In 1717 'Den Horen' was under control of master-brewer Sebastien Artois and for more than a century all the brewer's know-how was handed down from father to son. Around the turn of the century the brewing of the golden Pilsbeer of low fermentation was started up at Artois. In 1926 - and this for the first time - the brewery brought a barley beer onto the market and called it with the name 'Stella', the Latin word for 'Star'. The famous 'stella', a 'star' in the Brewers' Sky, is a beer that makes beer-fanciers feel at home.

To make our visit to Leuven complete, we will visit an artisanal chocolate factory, located just outside the city centre.

Visit to the National Botanic Garden of Belgium

The National Botanic Garden of Belgium is one of Europe's largest botanic gardens. Its location is just 4 km from the famous Atomium, and in easy reach of Brussels. You will discover a paradise for nature and plant lovers that extends over 92 ha. The Garden has a magnificent setting in the former royal Bouchout domain. The restoration of the Bouchout castle was finished in the 1980's. The castle is now used as a centre for conferences and exhibitions.

As many botanical gardens, the National Botanic Garden of Belgium combines research, conservation and education. The educational infrastructure includes systematic gardens, a medicinal garden, and a complex of 13 interconnecting glasshouses covering 1 ha.

They provide the visitor a quiet haven where he can discover about 18,000 plant taxa that grow in our garden. Apart from the public greenhouses, there are several smaller greenhouses containing special collections such as Orchidaceae, Agavaceae, carnivorous plants, ... The Botanic Garden also has an important Rubiaceae collection with about 260 taxa belonging to c. 100 genera.

Research conducted at the Botanic Garden covers many different disciplines, but is geographically concentrated on Western Europe and tropical Africa. Plant systematics and related fields such as floristics, phytogeography, molecular phylogeny, comparative morphology, pollen & spores and vegetation studies are all at the issue. Many taxonomic groups are studied: algae, bryophytes, fungi (including lichens and myxomycetes) and vascular plants.

The herbarium (BR), with c. 2.5 million specimens, belongs to the 25 largest of the world. Its main division is geographical (Tropical Africa, Belgium, and the 'General Herbarium' for the rest of the world). The families are arranged alphabetically. The herbarium contains many historical collections. The famous private collection of von Martius assembled for the realisation of Flora brasiliensis was acquired by the Belgian government even before the garden's existence. A few other important historical holdings include Henri Galeotti (Mexico 1835-1840) and Nicolas Funck & Louis Schlim (inter alia Colombia & Venezuela 14845-1852). Since the end of the nineteenth century,

the Garden's focus is on tropical Africa, especially Central Africa (Rwanda, Burundi, and R.D. Congo). The majority of botanical specimens ever collected in these countries are stored at BR.

In 2006, the important herbarium AWH ("Dr. Henri Van Heurck Museum") will be transferred as a permanent loan to BR. AWH was a dormant herbarium for a century now, but contains many important historical collections and types (e.g., Kotschy, von Reichenbach, Sieber, Spruce, Schimper, ...). The Rubiaceae collections will already be available for study during the Conference.

The library of the National Botanic Garden of Belgium is one of the most important in Europe concerning descriptive botany. The library collects, catalogues and conserves complementary documentation to the herbaria and the living plant collections to serve staff as well as users from all over the world. The library of the Garden currently holds 65,000 books, 5,000 journals and series, of which 1,300 current, and more than 10,000 offprints.

A free visit on Friday or Saturday will allow participants of the Rubiaceae Conference to enjoy the National Botanic Garden of Belgium. The library and special greenhouses (including the Rubiaceae collections) will only be accessible on Friday.

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Scripta Botanica Belgica 40

THIRD INTERNATIONAL RUBIACEAE CONFERENCE PROGRAMME & ABSTRACTS

The present issue gives the abstracts of the papers and posters presented at the Third International Rubiaceae Conference, held at the K.U.Leuven (Belgium) in 2006. Apart from Gentianales systematics, themes include subfamily, tribal and generic level taxonomy, biogeography and checklists of the pantropical family Rubiaceae.

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